

POPULATION MONITORING OF NEOTROPICAL
MIGRATORY BIRDS IN RIPARIAN
HABITATS OF UTAH

1992 - 2005 Summary Report

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EXECUTIVE SUMMARY

Utah Partners in Flight (UPIF), a cooperative organization of state, federal, private, and non-governmental organizations dedicated to conserve Utah's landbirds, established this study in 1992 to document bird population trends in Utah's riparian areas. The work was initially designed to compliment existing efforts, to respond to rising regional concerns, and to provide land managers and the public with relevant local information. Specifically, we designed the study to detect a 50% linear decline in abundance over 10 years with 80% power at an alpha level of 0.10.

This report summarizes the first 14 years of this on-going effort, and concludes that riparian bird populations have undergone statewide declines of approximately 5% per year during the 1992-2005 period. Linear trends in the two most sensitive metrics used in the study, abundance and annual survival, agree in the direction and magnitude of these declines. Declines observed in abundance are considered statistically significant. There was no significant linear trend in overall species richness. This first analysis is intentionally large-scale and taxonomically inclusive, capturing statewide patterns in broad strokes. On-going and planned analyses will work to detail the site, species, ecoregion, and agency-specific trends. These results do not implicate specific causes or mechanisms, but on-going management activities, concurrent regional drought, and regional anthropogenic impacts are briefly discussed.

This work represents the longest continuous study of this extent western North America. Thirty-one riparian sites were initially chosen for monitoring using point transect (detectability-corrected abundance estimation) beginning in 1992. Additional sites were added in later years; 37 sites with consistent data representing statewide patterns were chosen for this monitoring analysis: 15 sites total on Bureau of Land Management (BLM) managed lands, 13 on United

State Forest Service (USFS) managed lands, 2 sites on National Park Service (NPS) managed lands, 2 sites on United States Fish and Wildlife Service (USFWS) managed lands, and 5 on either Utah Division of Wildlife Resources (UDWR), Bureau of Reclamation (BOR), or privately managed lands. Four of these sites were selected for continuous effort mist net sampling (survivorship estimation via mark-recapture banding) beginning in 1994, with four more sites subsequently added. These 37 sites are most representative of low and mid-elevation riparian areas on publically managed lands.

Data from the study has established bench-marks for riparian habitats in Utah and the region. As such it represents a great success in UPIF's cooperative, diversified, funding model for long-term and large-scale applied ecological research. Current and future uses of these data include: 1) providing managers with the region- and habitat-specific set of references, with important estimates of natural variation, needed for assessments of habitat quality, management-action impacts, and restoration success; 2) providing managers and researchers with the first baseline abundances and survival estimates for many of Utah's riparian species; 3) estimating trends in population and survivorship for individual species of management concern; 4) correlational analyses designed to formulate testable hypotheses about the causes and scales of population change, and 5) compilation into bird species- and community-habitat associations designed to help guide conservation and restoration activities.

ACKNOWLEDGMENTS

The authors would like to thank our funders and site-hosts, without whose commitment this work could not have been sustained: the Utah State office of the Bureau of Land Management, the U.S. Forest Service Region 4, the Bureau of Reclamation and the Utah Reclamation Mitigation Conservation Commission, the U.S., Fish and Wildlife Service, the National Park Service, Rio Tinto (formerly Kennecott Copper), and the Nature Conservancy. Mary Conner (Utah State University) provided assistance with our MARK analyses; Len Thomas (University of St. Andrews) provided assistance with early Distance sampling analyses and power analyses. We also want to thanks the dozens of technicians and volunteers who have contributed their time, energy, and hard work to this effort over the years, many of whom have gone on to productive careers of their own in wildlife conservation.

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INTRODUCTION

This report documents the first 14 years, from 1992 to 2005, of the on-going Utah Partners in Flight (UPIF) riparian bird population monitoring project. In this report we present the study's inception, our goals, methods, and results for riparian bird population abundances, survivorship, and trends for this period. These results are discussed in the context of regional trend results, our study design's strengths and weaknesses, and both planned and future uses of these data. We also review the UPIF organizational history as it has served as the study's administrator, funding mechanism, and outlet for our results since 1993.

Conserving populations of land birds in Utah and across North America is the collective responsibility of numerous resource management agencies. The future of our birds starts with our cooperation and commitment to the conservation of these species. Through coordinated action, we can maximize our ability to conserve and enhance migratory bird species and their ecosystems. Utah Partners in Flight was organized in 1993 as the state's coordinating arm for non-game neotropical migrant land bird conservation. Through this effort we sought to link local concerns to national and international bird conservation initiatives and funding. Our initial concern was the fundamental lack of reliable local information.

We did not know the status of many avian populations within the state in 1992, and land managers and the public needed locally relevant data for status and trends of land birds in Utah. Providing reliable estimates of population size, trend, and monitoring important bird habitats, were major priorities in the development of our long-term management program. These goals for riparian habitats are embodied in this study, and this report is an important step in answering our early questions, while it also raises new ones. But these data do provide the information needed to confirm the importance of riparian areas and to catalyze our conservation actions.

Delivering conservation action is the collective next step for riparian habitats, arguably Utah's most important bird habitat.

Of the 440 species of birds that occur in Utah (Utah Ornithological Society Bird Records Committee 2008), at least 231 (~53%) are considered residents in Utah (Parrish et al. 2002). Of these, approximately half are classified as neotropical migratory birds (Gauthreaux 1991), the group considered to be at greatest risk in the early 1990's (e.g., Finch and Stangel 1992). Despite the growing concerns, relatively little was known about the population status and trends of most of these species in Utah's riparian habitats. Over 70% of Utah's birds use riparian habitat for most or some portions of their life cycle (Walters and Sorensen 1983, Parrish et al. 2002). While the national-level Breeding Bird Survey (BBS) does provide adequate annual monitoring of several Utah bird species, the BBS program was not initially habitat specific, is road-based (and hence road-biased), and did not adequately monitor breeding birds in Utah's notably discrete riparian habitats. The strength of the BBS is its continental extent, its seamless inference, and its ability to detect regional and national-scale trends impossible to detect via patch-work local studies. Its design sacrifices resolution for breadth, however, and it lacks the power to provide Utah's land managers and the public with early indications of habitat specific population declines. Without these early warnings, conservation and management actions needed to stabilize or reverse population declines in species in danger of becoming Threatened or Endangered under ESA become increasingly expensive and difficult to accomplish.

Begun with 31 study sites in 1992, this study was designed to supplement the BBS by monitoring birds in riparian habitats using a point transect methodology. The study was initially established through a partnership between the Utah Division of Wildlife Resources (UDWR), U.S. Fish and Wildlife Service (USFWS), and the Kennecott Corporation (a private partner). We

subsequently expanded the program in 1994 to include the partnership and cooperation of the U.S. Bureau of Land Management (BLM), the U.S. Forest Service (USFS), the U.S. Bureau of Reclamation (BOR), and the Utah Reclamation, Mitigation, and Conservation Commission (UMCC). This multi-agency cooperation allowed better spatial coverage and statistical power through the addition of up to 41 sites (37 are currently monitored). Our study was initially designed to:

- determine riparian bird population trends by species, ecoregion, and individual sites where the ‘trend’ goal was formalized as the ability to detect a linearly declining population trends over 5% per year (effect size), with 80% power, and reasonable confidence (an alpha of 0.05) within ten years;
- provide reference standards for potential induced changes in habitat quality or quantity;
- test for needed number of visits (varied between 2-5) for sample-size and power (allocation of inter- vs. intra-annual effort),
- field test the ‘new’ distance-sampling field protocol used to correct for potentially important detectability issues.

As no riparian inventory was initially available, riparian habitats were stratified into sub-categories, and hence representative samples were drawn from the best sampling frame available at the time: 1:100,000 grid cells. This approach had several strengths, but also inherent biases against high elevation riparian habitats, smallest and largest stream/river orders, and toward publically accessible / managed lands.

The constant effort mist netting portion of the study (i.e., bird banding) was added in 1994 at four sites to compliment the abundance and trend data collected at all sites and to investigate survivorship and productivity trends as part of the Monitoring Avian Productivity and

Survivorship (MAPS) program, a nationwide survey methodology developed at Point Reyes Bird Observatory (De Sante et al. 1995). Our satellite goals were to have a means of identifying potential mechanisms of observed population-level changes, to provide the missing parameters needed to conduct Utah-specific population modeling, and to provide a comparison on count vs. banding perspectives on the same bird community. These studies were later expanded to eight sites.

Baseline information on habitat characteristics and bird species composition, abundance, and diversity has been collected at each site. This intensity and consistency of sampling effort has provided a statistically rigorous and defensible approach for assessment of avian populations that will prove useful to agencies attempting to effectively manage Utah's riparian habitats for birds. In this report, we focus on population status and trends of all Utah birds in riparian habitats statewide. These investigations were conducted using inclusive taxonomic and spatial terms in order to provide a comprehensive perspective and a broad foundation for the more detailed analyses to come. More specific analyses are in progress and data collected for riparian habitats are being compiled into a riparian handbook that will be available in 2009. Finally, we emphasize that while these are initial results, they capture the broad community- and state-wide trends of Utah's riparian bird populations. They also underscore the effort and commitment needed for successful long-term, large-scale monitoring necessary to effectively determine habitat-specific trends in avian populations.

STUDY AREA

Our study area consisted of riparian habitat occurring statewide within Utah (Fig. 1). For the purpose of this study, we defined riparian bird habitat as the vegetation found along rivers and streams of all orders and elevations. This represents an area of less than 1% of the state

(Prior-Magee et al. 2007). Riparian habitats in Utah range in elevation from approximately 610 m to over 3500 m, and vary considerably in terms of the dominant plant species comprising this habitat type across this broad elevation range. Our definition was therefore conceptually broad as we intended it to be geographically and elevationally inclusive for all riparian habitat in the state. While we recognize the utility vegetation community based sub-categories (e.g., Padgett et al. 1989), these were unavailable as a sampling frame and not used in the study design *a priori*. No detailed statewide riparian habitat inventory existed when the study was begun, nor exists today; as such, both our sphere of inference and sampling frame were left necessarily flexible to accommodate pilot data and field checks. The only *a priori* strata used were ecoregional boundaries (Fig. 1) and land management agency responsibility (e.g., Figures 2 and 3).

STUDY DESIGN

Our study was designed to assess riparian bird population trends in riparian habitats statewide, both as a group and as individual species wherever possible. To ensure comprehensive and representative spatial coverage of the state needed to accomplish this, we used a 1:100,000 scale SGID grid (30 x 60 min quadrangle, C. Clark, Pers. Comm., Utah AGRC) and GIS stream coverage as the sampling frame to distribute survey sites. Non-ephemeral river and stream segments in each grid cell were randomly numbered, providing a random rank order. Segments were visited in rank order, and the first one with suitable extent of riparian vegetation (> 100 x 3000 m) with public access was selected as a study site. If no suitable site was available at the given location, the next ranked site was visited. If none of the top 3 sites were found to be suitable the quadrangle itself was skipped. Using this approach, thirty-one sites were initially selected in 1992 (Table 1, Fig. 1), with 6 additional sites added in subsequent years.

UDWR Riparian Study Sites with Ecoregional Boundaries

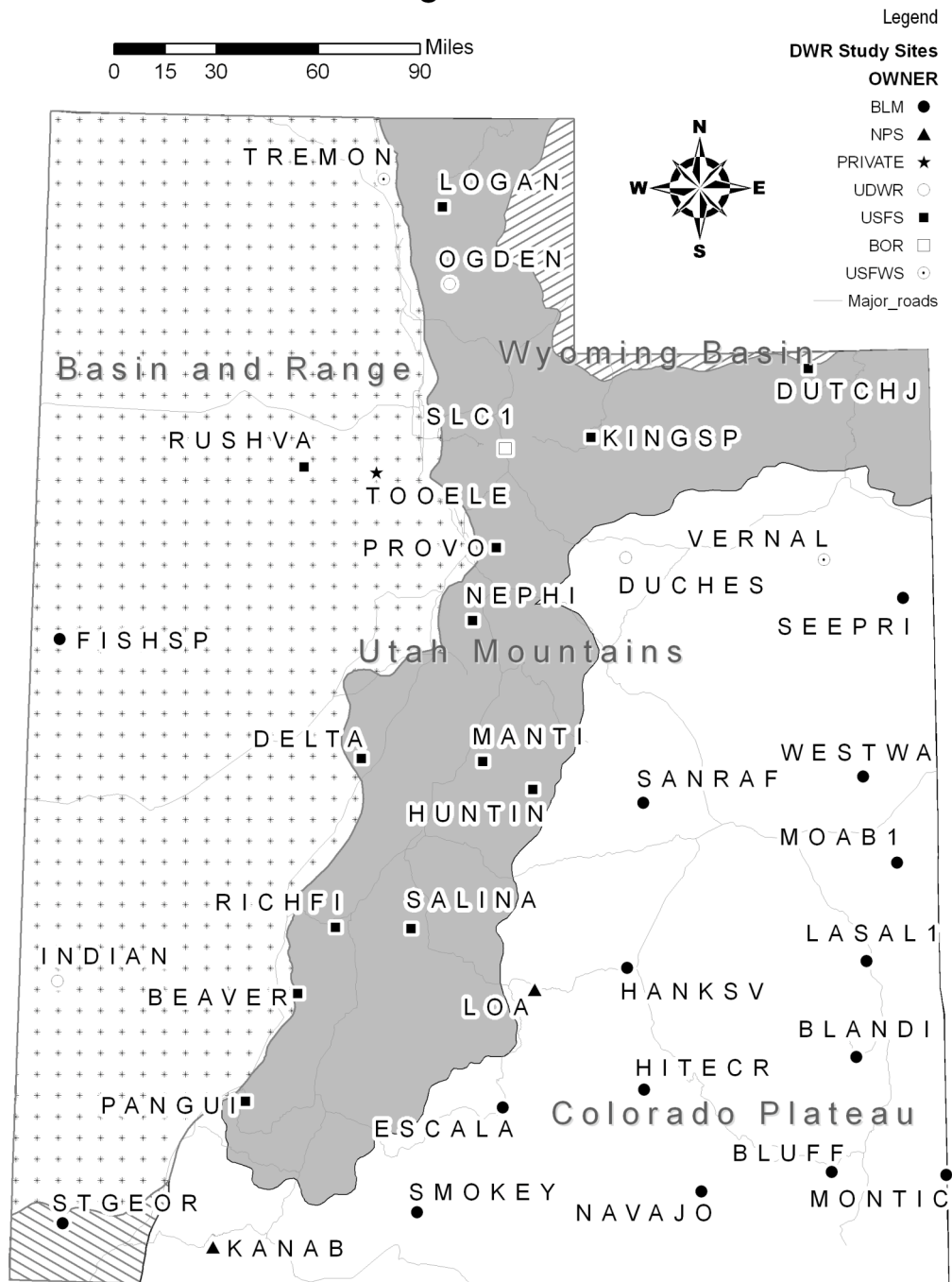


FIG.1. Approximate riparian study site locations with land management agency indicated by symbol type. Ecoregional boundaries and major roads are also shown.

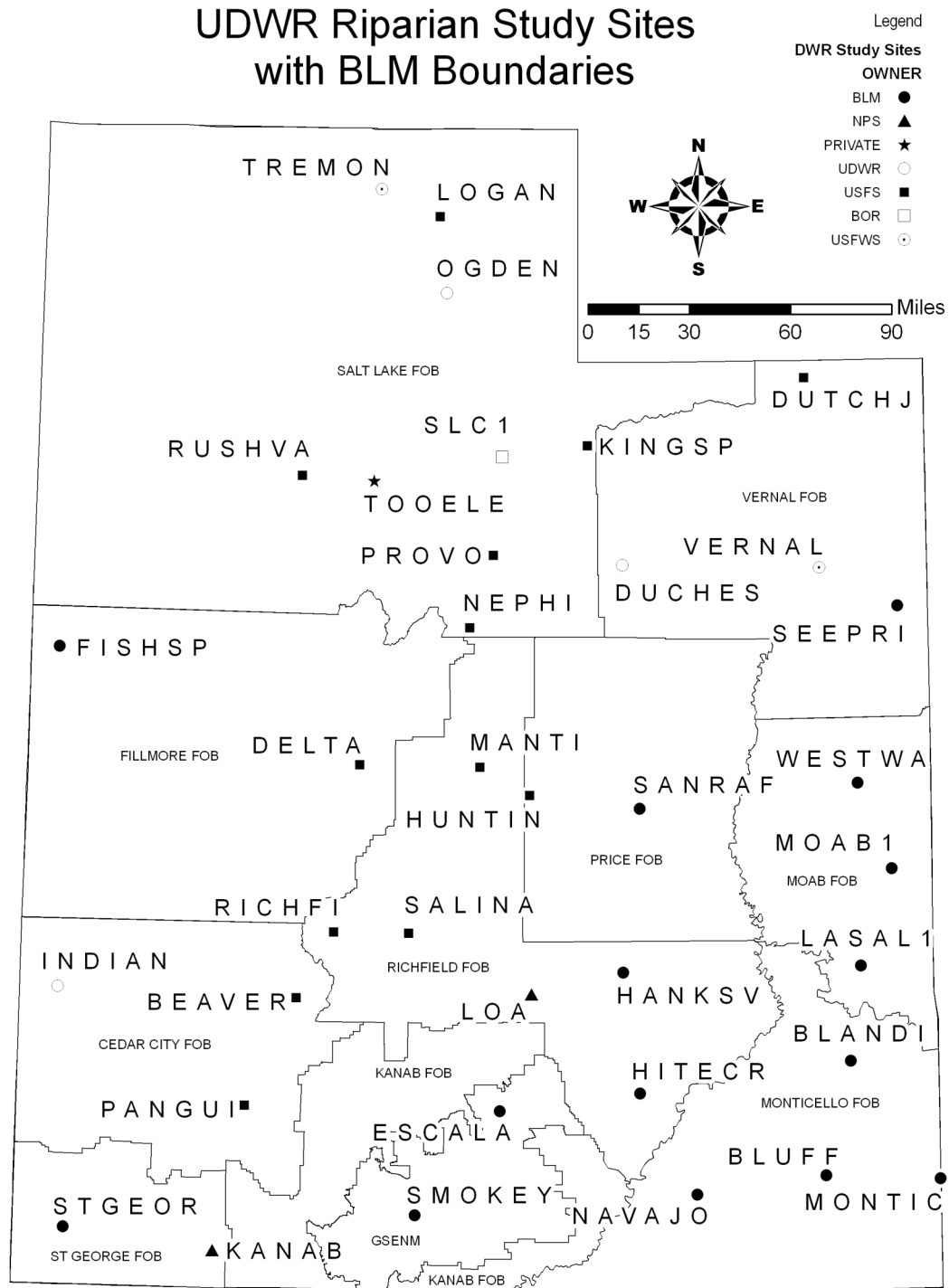


FIG. 2. Approximate riparian study site locations with land management agency indicated by symbol type. Bureau of Land Management boundaries are also shown.

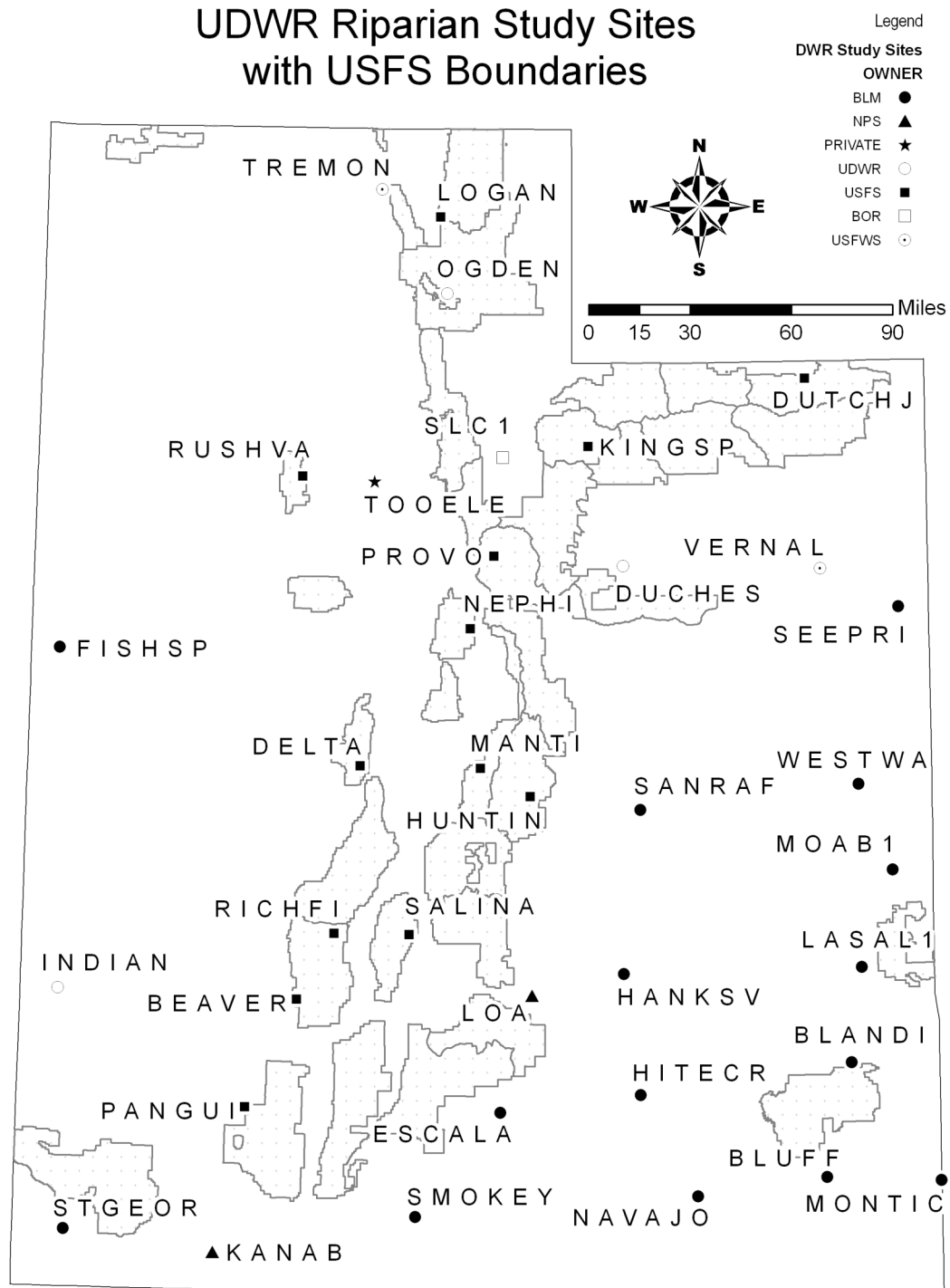


FIG. 3. Approximate riparian study site locations with land management agency indicated by symbol type. United States Forest Service boundaries are also shown.

Years in which sites were not run (typically due to logistical issues) are detailed in the Results section.

In all, 15 sites were established in riparian habitats on BLM managed lands. Of these, four were established within the Monticello Field Office, three within the Moab Field Office, two within the Henry Mountains Field Station of the Richfield Field Office, two within Grand Staircase/Escalante National Monument, and one site each within the Vernal, Price, Fillmore, and St. George Field Offices (Fig. 2). Thirteen sites were established on USFS administered lands (Fig. 3). Of these, four sites are located within Fishlake National Forest, three sites are located within Wasatch-Cache National Forest, two each are located within Manti-LaSal and Uinta National Forests, and one site each is located within Ashley and Dixie National Forests. Nine additional sites were also selected (Figs. 1-3). Two sites were established within NPS managed lands, one in Capitol Reef National Park and one within a portion of Zion National Park. Two sites were established within USFWS managed lands, one on Bear River Migratory Bird Refuge and one on Ouray National Wildlife Refuge. The sole BOR site is located along the Provo River below Jordanelle Dam and Reservoir in Wasatch County north of Heber City, Utah. The three UDWR sites are located in Duchesne County (Northeastern Region), in Beaver County (Southern Region), in Weber County (Northern Region). One site is located on private land (i.e., Kennecott Copper, now Rio Tinto Corp.) in Butterfield Canyon in Tooele County. Ten point transect locations were established in each selected survey site using the ‘point count’ approach later codified in Ralph et al (1993): approximately 250 m spacing between points (150 m minimum), points located in suitable habitat away from edges, and in small openings to facilitate bird observations. Not every selected site ultimately had sufficient habitat for 10 points (i.e., two sites, TREMON and NAVAJO, contain only 8 points), and as a result all data are

standardized by survey effort (see Analysis Methods section for details). To account for within-season temporal variability, two visits were made to each site in each year. A subset of sites were visited 5 times each season to investigate the effects of survey effort on study efficiency and trend estimation.

Beginning in 1994, constant effort mist net sampling was added to the design. Four survey sites were selected (Table 2), and nets co-located with each point transect location as closely as possible. Factors considered in selection of these sites for mist net surveys included: 1) numbers of birds detected during point transect surveys, 2) land ownership (e.g., preference was given to sites located on non-private lands), and 3) ease of access to locations for long-term placement and monitoring of mist nets. These 4 initial sites were SLC1, the BOR site along the Provo River in Wasatch County, NEPHI, the Nephi Site along Nebo Creek and Page Fork on USFS lands in Utah County, RUSHVA, the Rush Valley site located on USFS lands in Tooele County, and STGEOR, the St. George site located on BLM lands in Washington County along the Santa Clara River. In subsequent years, mist net surveys were initiated at 4 additional sites: DUTCHJ, the Dutch John site located on USFS lands in Daggett County (1995), SMOKEY, the Smokey Mountain site located on BLM lands in Kane County (1997), MONTIC, the Monticello site located on BLM lands in San Juan County (1998), and BLANDI, the Blanding site located on BLM lands (2002).

To reduce observer-induced bias, a potentially significant source of error for long-terms and large-scale trend studies, observers hired for both the count and the banding portions of the study had a minimum of one season prior experience and were additionally trained in our study methods, typically for a week at the onset of the season. Count observers were rotated through sites, and visits to sites, in a North-South panel design with balanced effort within each panel. In

all portions of the study, we sought to retain experienced, trained observers whenever possible to reduced observer-turnover induced bias, and we currently maintain an over 65% retention rate in our trained field personnel.

TABLE 1. Riparian study site attributes. Site names are coded by the 1:100,000 scales quadrangle cell name in which they are located.

Site Name	Management Unit	SiteCode	Begun	Elev (m)
Blanding*	BLM, Monticello Field Office	BLANDI	1993	1872
Bluff	BLM, Monticello Field Office	BLUFF	1992	1458
Escalante	BLM, GS/E National Monument	ESCALA	1992	1586
Fish Springs	BLM, Fillmore Field Office	FISHSP	1996	1937
Hanksville	BLM, Richfield Field Office	HANKSV	1992	1319
Hite Crossing	BLM, Richfield Field Office	HITECR	1992	1910
LaSal 1	BLM, Moab Field Office	LASAL1	1992	1555
Moab 1	BLM, Moab Field Office	MOAB1	1992	1261
Monticello*	BLM, Monticello Field Office	MONTIC	1998	1555
Navajo Mtn.	BLM, Monticello Field Office	NAVAJO	1992	1612
San Rafael	BLM, Price Field Office	SANRAF	1995	1557
Seep Ridge	BLM, Vernal Field Office	SEEPRI	1992	1501
Smokey Mtn.*	BLM, GS/E National Monument	SMOKEY	1992	1597
St. George*	BLM, St. George Field Office	STGEOR	1992	1068
Westwater	BLM, Moab Field Office	WESTWA	1992	1652
Beaver	USFS, Fishlake National Forest	BEAVER	1992	1980
Delta	USFS, Fishlake National Forest	DELTA	1992	2050

Site Name	Management Unit	SiteCode	Begun	Elev (m)
Dutch John*	USFS, Ashley National Forest	DUTCHJ	1992	1898
Huntington	USFS, Manti-LaSal National Forest	HUNTIN	1992	1973
King's Peak	USFS, Wasatch-Cache National Forest	KINGSP	1992	2773
Logan	USFS, Wasatch-Cache National Forest	LOGAN	1992	1458
Manti	USFS, Manti-LaSal National Forest	MANTI	1992	2252
Nephi*	USFS, Uinta National Forest	NEPHI	1992	1864
Panguitch	USFS, Dixie National Forest	PANGUI	1992	2066
Provo	USFS, Uinta National Forest	PROVO	1992	1598
Richfield	USFS, Fishlake National Forest	RICHFI	1992	2056
Rush Valley*	USFS, Wasatch-Cache National Forest	RUSHVA	1992	1814
Salina	USFS, Fishlake National Forest	SALINA	1992	2318
Tremonton	USFWS, Bear River Migratory Bird Refuge	TREMON	1992	1297
Vernal	USFWS, Ouray National Wildlife Refuge	VERNAL	1992	1401
Kanab	NPS, Zion National Park	KANAB	1992	1199
Loa	NPS, Capitol Reef National Park	LOA	1992	1669
Salt Lake City	Reclamation Mitigation & Conservation			
1	Comm.	SLC1	1992	1794
Duchesne	UDWR, Northeastern Region	DUCHES	1995	1866
Indian Peak	UDWR, Southern Region	INDIAN	1996	2162
Ogden	UDWR, Northern Region	OGDEN	1992	1569
Tooele	Kennecott Corporation	TOOELE	1992	1982

*- Indicates sites selected for constant effort mist net surveys

TABLE 2. Banding site data summary. The initiation date for each site is given (e.g., the DUTCHJ site was begun in 1995) as is the mean number of birds encountered per net hour for all 8 banding sites and for each managing agency. See Table 1 for site names and descriptions.

Site	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
DUTCHJ		523.8	751.7	754.8	740.3	715.3	701.8	722.0	750.5	671.3	601.2	620.3	7553.2
BLANDI									714.5	748.8	713.2	527.8	2704.3
MONTIC					618.5	631.7	728.7	727.8	678.2	742.7	628.7	545.4	5301.5
NEPHI	648.3	465.2	778.3	753.8	743.5	711.5	714.5	695.3	726.2	732.8	627.5	381.5	7978.6
RUSHVA	617.0	609.3	763.3	751.8	759.9	718.8	708.7	732.3	757.0	722.0	515.8	526.0	8182.0
SLC1	633.3	505.0	768.0	759.7	728.3	745.5	743.8	732.5	743.0	728.3	631.8	630.3	8349.7
SMOKEY				758.2	677.7	659.5	724.3	705.0	734.0	731.3	682.0	669.7	6341.7
STGEOR	585.5	646.8	714.0	721.5	704.0	727.7	740.7	737.5	741.3	733.5	764.3	663.2	8480.0
BLM total	585.5	646.8	714.0	1479.7	2000.2	2018.8	2193.7	2170.4	2868.0	2956.3	2788.2	2406.0	22827.6
USFS total	1265.3	1598.4	2293.3	2260.5	2243.7	2145.7	2125.0	2149.7	2233.7	2126.2	1744.5	1527.8	23713.8
BOR total	633.3	505.0	768.0	759.7	728.3	745.5	743.8	732.5	743.0	728.3	631.8	630.3	8349.7
Grand total	2484.2	2750.2	3775.3	4499.9	4972.2	4910.0	5062.5	5052.5	5844.7	5810.9	5164.5	4564.2	54891.1

METHODS

Field methods

Point Transects – Each site was surveyed at least twice per breeding season by trained technicians; a subset of sites was surveyed up to 5 times each season (allowing for a later investigation into survey design efficiency). Counts were conducted from 15 minutes before official sunrise until approximately 10:00 am on each scheduled sampling day from mid-May through late-June each year. During a site visit (i.e., sampling event), each point was surveyed using an eight-minute variable radius point transect, based on Ralph et al. (1993) and Buckland et al. (2001). Each 8-minute count was divided into three periods (0-3 minutes, 3-5 minutes, and 5-8 minutes) to facilitate comparison with other data sources such as the 3-minute duration BBS count period. Data collected for each observation included species, distance from the survey point to the detected bird, flock size, whether the bird was first detected by singing (audible detection), direct observation (visible detection) or both. The age and sex of the bird was also collected whenever possible.

Constant Effort Mist Net Surveys – ‘Constant Effort’ mist net surveys were carried out in accordance with Ralph et al. (1993) and protocols established for the Monitoring Avian Productivity and Survivorship (MAPS) Program (De Sante et al. 1995). Mist net sampling at selected sites is conducted within 10 to 12 ten-day ‘blocks’ each year, from May through August. A standard mist net survey consists of 10 mist nets, each net measuring approximately 3 meters high and 14 meters long when fully extended. Nets are opened within 30 minutes of official sunrise and operated for six hours each, for a total of approximately 60 net hours per individual survey. Some or all nets are closed early during any given sampling effort when high

temperatures, rain, or high winds develop that could cause injury or death to the birds. Further, there have been occasions when nets were closed early or not opened at a given site due to a variety of unusual circumstances (e.g., high water, presence of bears, fallen trees at sampling location, or predators killing or attempting to kill birds in nets). Each bird captured was banded with a U.S. Fish and Wildlife Service numbered leg band and released. In addition, data collected from captured birds included species, age, sex, weight, wing length, an assessment of fat content, an assessment of breeding condition, an assessment of feather wear and molt condition, time of capture, and general observations. Field schedules were composed in such a way as to prevent a point-transect survey and a mist-net survey from being scheduled simultaneously at a given survey site.

Analysis methods

Point Transect Data Analysis — All point transect analyses in this report are based on data from 37 sites for which complete (balanced) data exists for at least 5 years. Three analyses are presented. The first is a site-by-year species richness comparison (alpha diversity, s), calculated as the sum of unique species detected across each standardized survey event (standardized by survey effort, e.g., number of points, number of visits). The second analysis is a site-by-year comparison of estimated abundance (estimated density, \hat{D}) using distance-sampling estimation techniques and program Distance (version 5.5, Thomas 2005) to standardize for detectability and survey effort differences in a multi-model inference approach (Buckland et al. 2001, Burnham and Anderson 2002). The third analysis is an ordinary least-squares linear trend analysis that uses the estimated densities to model linear changes in total bird abundance from 1992 to 2005 statewide, for each managing agency, and at each survey site.

Observations of individual birds not conclusively identified to species were excluded from all analyses. Birds considered to be passing over the habitat (and not through it, e.g., 'fly-overs') and observations to which distances could not be accurately estimated were also excluded from distance sampling analysis. The transect (aka site) is considered the sampling unit in all analyses, not the point, because while individual points within transects are considered statistically independent at the scale of bird observations (e.g., 100's of meters), they are not considered statistically independent at the spatial scale of the investigation itself (e.g., 100's of kilometers).

Constant Effort Data Analysis — Three banding analyses are presented here: recapture probabilities by year, by site, and survivorship by site and year. Attempts to determine productivity estimates were not conducted due to insufficient data on juveniles having been collected at banding sites. All analyses are based on constant effort mist net data from pooled (all species) data drawn from the eight banding sites, using methods described in White and Burnham (2000) and the analysis approach exemplified by Anthony et al. (2006). Recapture and survivorship rates are estimated from recapture data pooled across species using Program MARK (White and Burnham 2000), where 'recapture data' refers to those birds that were initially banded at a given site and later recaptured. Data for all species were pooled to have sufficient power to estimate trends in recapture and survivorship estimates at all sites in each year. Species richness is here defined as the sum of unique species captured at a given visit to a given site, expressed as an average of the total number of visits accomplished. Richness and birds per net hour, a standardized measure of mist net survey efficiency, is also calculated for site-by-year comparisons.



RESULTS

Point Transect Survey Results

Statewide Results — A total of 210 species and 142,953 individuals were detected during 1,283 point transect surveys conducted from 1992 – 2005, for an average of 10,211 birds/year and 111.4 birds/survey (Tables 3 and 4). The highest number of species observed statewide in a single year was 157 species in 1999, and the least number of species detected statewide (113) occurred in 1992. Mean statewide annual species richness was 135.6, and the mean (across visits within year) site annual richness was 35.8 species (Table 3, Fig. 4). Mean annual site richness was varied from a high of 67 (SLC1 site, 1999 and 2003) to a low of 6 (FISHSP site, 1997) (Table 3, Fig. 4). There was no significant linear trend in statewide species richness (Fig. 4). Of

all species recorded, 87 were observed at least once in all 14 years, and 101 species were observed in all but one year (Table 4). In addition, a total of 18 species were observed at all sites, and 27 species were observed at only one site. There were 12 species for which only a single detection was recorded. Thirteen species accounted for over half (51%) of all birds detected; 32 species accounted for over 75% of all detections recorded, and the most frequently detected species, the Yellow Warbler (*Dendroica petechia*), accounted for 10.2% of all recorded observations (Table 4). Annual lists of the species observed and their frequency of observation are given for BLM, USFS, USFWS, and NPS managed sites in Tables 5 to 8 respectively, and for each survey site individually in Appendix A.

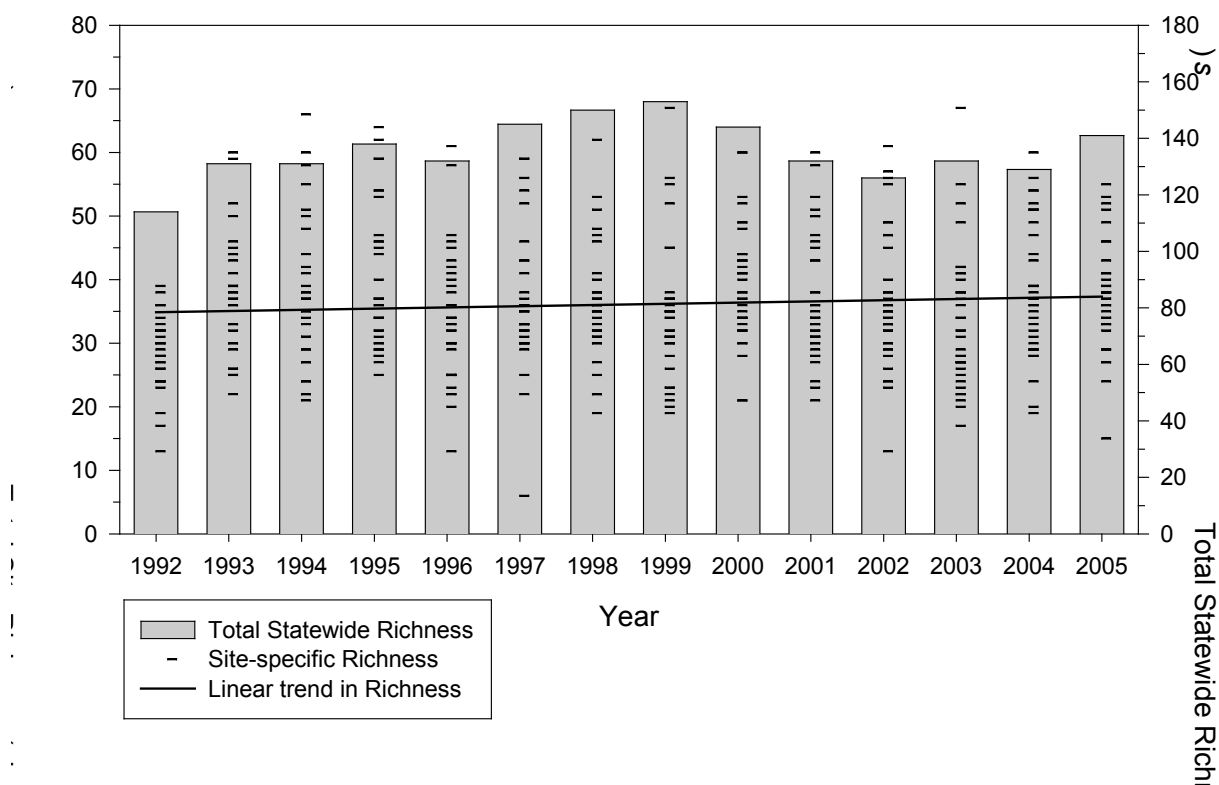


FIG. 4. Linear trend in annual observed richness. Left hand y-axis shows annual site richness (hatch marks), right hand y-axis shows statewide annual richness (histogram).

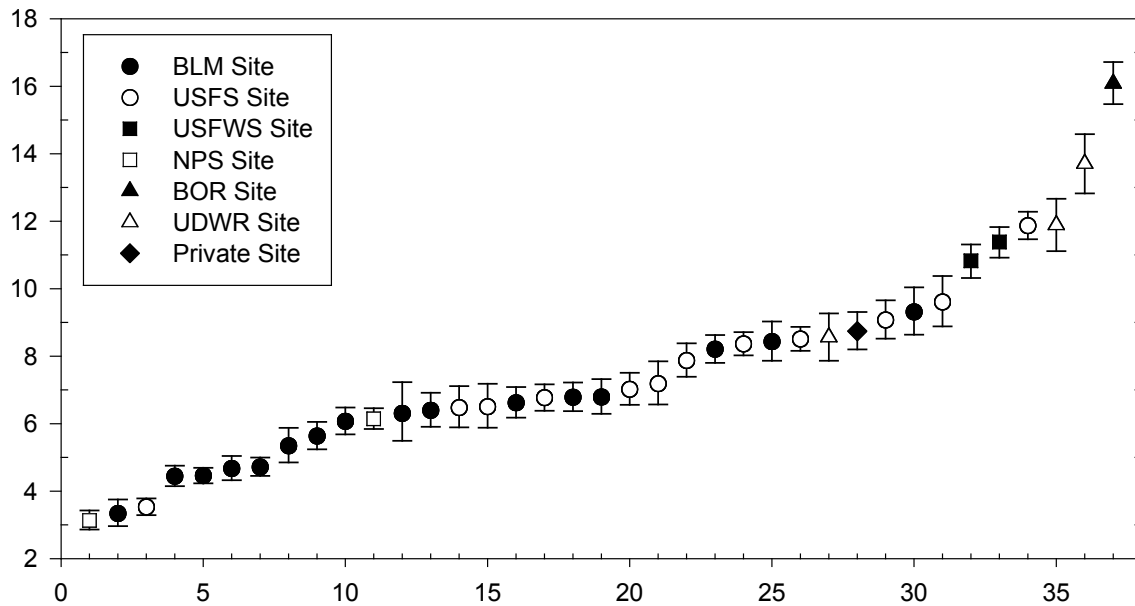


FIG. 5. Sites ranked by mean annual density (birds/ac, with 95% CI). Symbols differentiate site management

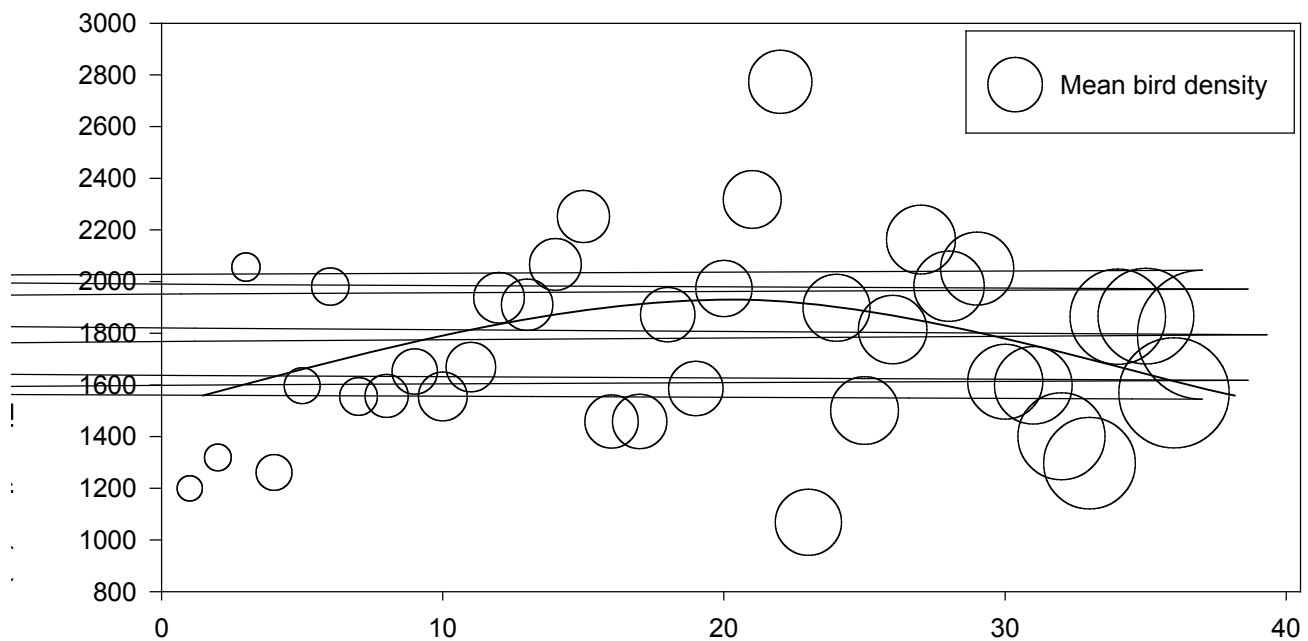


FIG. 6. Sites ranked by mean annual density (birds/ac) along x-axis and by elevation along the y-axis. The approximated curvilinear trend with elevation is also shown.

TABLE 3. Total observed species richness, for all sites in all years. Totals given in the right hand column reflect the total (all years combined) richness for each survey site; totals in the columns reflect statewide totals (all sites combined) for each year.

Site	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
BLANDI		36	22	36	32	23	26	35	35	25	29	22	32	36	86
BLUFF	26	39	37	34	34	37	36	35	34	33	34	22	28	37	86
ESCALA	24	29	37	30	34	36	37	34	34	30	34	29	47	27	80
FISHSP					13	6	22	19	21	23	13	17	20	15	54
HANKSV	30	41	39	37	36	33	38	37	43	31	32	32	35	46	97
HITECR	17	26	27	32	22	33	35	34	32	21	23	28	36	29	79
LASALI	26	44	33	36	30	30	22	26	34	32	33	25	39	43	79
MOABI	27	46	42	46	36	41	47	31	42	43	37	34	19	36	84
MONTIC							19	21	34	38	47	38	60	53	91
NAVAJO	24	36	37	34	40	36	35	30	41	33	33	23	33	41	84
SANRAF				27	23	22	31	28	38	27	40	34	24	37	80
SEEPRI	24	33	22	47	38	32	35	35	44	36	35	40	39	36	84
SMOKEY	34	43	50	54	39	46	38	38	43	45	35	36	51	49	99
STGEOR	32	39	60	54	42	52	46	45	60	47	49	41	51	52	109
WESTWA	23	24	29	35	22	30	25	29	36	29	19	18	28	25	70
BEAVER	23	22	21	31	25	30	27	35	32	24	24	22	29	24	73
DELTA	36	39	38	34	34	35	30	20	43	34	38	37	37	29	85
DUTCHJ	39	59	55	62	58	59	51	55	60	43	56	52	54	51	107
HUNTIN	28	30	24	28	25	35	32	23	37	31	29	27	29	38	72
KINGSP	19	25	27	25	25	32	31	32	21	28	32	27	38	27	72
LOGAN	29	36	31	30	22	38	36	31	30	31	30	31	28	29	79
MANTI	24	25	29	29	25	30	25	30	32	28	26	28	32	32	73
NEPHI	32	50	41	46	43	43	41	36	52	50	49	55	56	40	89
PANGUI	28	33	29	40	30	29	34	22	30	34	24	27	29	34	74
PROVO	27	26	31	29	20	32	31	30	33	32	30	21	31	33	71
RICHFI	36	32	34	32	32	32	33	32	41	30	28	26	34	34	84
RUSHVA	30	45	44	45	46	54	53	45	53	58	55	49	51	46	105
SALINA	31	38	35	36	32	33	30	35	41	38	33	38	39	41	81
TREMON	32	60	66	59	41	59	48	52	49	60	47	38	37	38	111
VERNAL	38		51	59	45	30	40	56	28	53	57	24	52	39	109
KANAB	13	38	22	29	33	30	36	37	35	29	36	20	30	38	83
LOA	30	44	48	53	47	43	37	31	40	50	36	27	36	38	98
SLC1	33	52	58	64	61	56	62	67	48	46	61	67	54	55	112
DUCHES				44	33	36	35	37	49	51	45	42	49	33	93
INDIAN					30	25	32	37	44	36	38	42	37	38	86
OGDEN	32	37	38	37	29	33	37	35	38	34	38	41	44	35	87
TOOELE	32	37	35	37	30	31	38	31	36	35	35	32	43	39	78
TOTAL	114	131	131	138	132	145	150	153	144	132	126	132	129	141	210

Table 4. Total numbers of observations, by species, made during point transect surveys conducted in riparian habitat statewide from 1992 – 2005 for all 37 survey sites combined.

Common Name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Yellow Warbler	181	661	1025	748	720	693	726	1851	1570	1545	1222	706	1332	1531	14511
Spotted Towhee	242	475	672	697	642	522	596	1635	1251	890	970	670	877	797	10936
American Robin	283	889	853	902	839	556	589	1266	1064	866	664	444	628	721	10564
Warbling Vireo	166	557	378	346	335	476	521	405	485	506	635	646	755	803	7014
Mourning Dove	185	227	481	268	291	220	171	700	433	404	350	213	467	335	4745
Violet-green Swallow	132	358	159	532	212	400	423	146	215	242	330	269	335	349	4102
Song Sparrow	45	159	165	282	272	205	284	606	337	232	318	174	319	343	3741
Brown-headed Cowbird	64	184	170	205	148	222	217	477	309	394	327	124	238	328	3407
Lazuli Bunting	199	396	204	236	181	179	250	206	135	242	194	289	271	415	3397
White-throated Swift	116	420	138	295	188	207	184	161	237	140	68	182	261	293	2890
Ash-throated Flycatcher	100	183	142	179	133	140	142	63	198	223	248	261	365	304	2681
Broad-tailed Hummingbird	162	308	240	272	198	154	168	81	166	201	178	101	126	296	2651
Plumbeous Vireo	119	211	178	241	182	180	153	67	96	157	277	215	279	266	2621
American Goldfinch	125	260	335	318	226	135	115	148	172	131	93	102	164	207	2531
Cliff Swallow	142	195	28	358	198	137	150	354	222	109	91	84	73	372	2513
Black-headed Grosbeak	49	133	199	246	123	135	166	112	127	153	195	192	243	170	2243
House Wren	112	186	294	272	174	125	137	141	69	77	49	107	167	169	2079
Yellow-breasted Chat	42	163	90	162	136	132	151	84	190	191	134	177	186	231	2069
Blue-gray Gnatcatcher	69	131	79	122	52	89	100	60	86	192	227	138	265	356	1966
Chipping Sparrow	97	109	110	121	132	125	123	71	158	126	101	127	254	200	1854
Red-shafted Flicker	32	109	168	188	136	72	113	151	336	159	137	60	93	98	1852
Western Tanager	32	102	102	91	58	78	117	117	187	129	88	266	176	185	1728
Cassin's Finch	33	89	49	118	92	117	41	791	76	90	107	20	49	34	1706
Black-capped Chickadee	75	81	128	152	113	49	92	82	164	157	149	55	207	182	1686
Western Wood-Pewee	112	93	105	73	57	80	77	265	173	169	107	74	176	114	1675
Bullock's Oriole	26	112	133	148	77	78	80	131	127	216	159	103	96	139	1625
Audubon's Warbler	5	48	139	143	76	39	81	19	193	51	287	106	82	173	1442
MacGillivray's Warbler	43	67	94	47	71	70	97	73	181	99	184	118	136	162	1442
Lesser Goldfinch	78	212	90	144	74	168	80	122	25	61	15	41	93	227	1430
Virginia's Warbler	37	56	69	47	60	66	71	107	113	339	68	92	149	109	1383
Red-winged Blackbird	8	54	72	92	102	82	91	289	107	121	81	54	85	111	1349

Common Name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
House Finch	40	32	54	69	55	13	30	168	379	32	44	46	199	162	1323
Pine Siskin	64	100	63	65	39	112	55	126	172	70	178	26	54	180	1304
Hermit Thrush	63	110	106	122	108	83	88	55	128	85	70	76	129	58	1281
Rock Wren	73	108	55	66	29	49	40	327	90	54	38	55	117	109	1210
Common Raven	16	53	63	57	58	38	56	158	151	88	117	83	99	140	1177
Tree Swallow	141	40	102	31	82	29	58	258	200	108	72	17	2	17	1157
Bushtit	55	44	81	19	39	30	105	99	299	41	108	88	46	98	1152
Black-billed Magpie	36	114	131	110	85	81	56	60	105	92	52	70	67	79	1138
N. Rough-winged Swallow	3	139	145	287	34	54	48	15	18	34	18	14	39	141	989
Pinyon Jay	5	1	41	17	16	4	82	368	174	69	93	90	28	1	989
Mountain Chickadee	86	54	79	109	54	44	44	26	52	37	33	109	127	98	952
Dusky Flycatcher	39	14	46	32	41	112	109	66	57	64	65	109	98	77	929
Bewick's Wren	5	35	63	29	25	56	59	14	32	15	63	93	141	147	777
Canyon Wren	35	37	36	32	39	52	52	191	67	36	29	31	54	63	754
Mallard	1	31	53	90	54	51	39	167	43	56	39	15	26	56	721
Black-throated Gray Warbler	27	29	27	40	12	39	45	20	72	44	96	61	90	110	712
Black-chinned Hummingbird	6	45	26	42	52	41	31	141	86	45	10	15	95	59	694
Green-tailed Towhee	50	77	58	57	61	40	51	28	36	52	48	46	42	40	686
Dark-eyed Junco	18	14	5	29	11	15	16	143	116	38	107	23	72	66	673
Canada Goose		33	43	113	62	44	18	120	35	28	75	20	34	41	666
Cedar Waxwing	25	70	41	66	33	33	31	59	56	54	23	44	30	81	646
Yellow-headed Blackbird	14	7	30	20	27	40	32	176	52	86	35	46	16	42	623
European Starling	2	42	37	137	69	40	66	31	25	64	18	14	42	15	602
Lucy's Warbler	5	42	56	62	22	38	21	175	51	11	24	14	18	53	592
Western Kingbird	6	25	28	25	23	16	15	78	80	75	31	30	47	53	532
Ring-necked Pheasant	8	32	53	46	37	39	11	93	43	60	36	23	20	28	529
Ruby-crowned Kinglet	6	46	42	73	31	23	14	20	13	23	12	61	60	79	503
Spotted Sandpiper	45	49	38	51	38	34	20	24	24	45	39	33	19	30	489
Blue Grosbeak	25	40	20	35	13	34	55	37	31	35	17	57	58	30	487
Brewer's Blackbird	11	37	106	78	98	8	11	18	44	37	10	15	9	5	487
Western Scrub-Jay	28	17	22	39	34	41	68	10	32	19	56	36	40	34	476
Cordilleran Flycatcher	16	19	11	16	5	16	23	28	31	13	9	35	102	106	430
Western Meadowlark	11	44	56	72	21	12	13	40	30	24	26	3	23	26	401
Orange-crowned Warbler	5	7	39	15	12	20	32	20	15	53	58	34	51	36	397
American Kestrel	17	33	32	24	26	35	27	18	39	24	18	32	32	18	375

Common Name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Steller's Jay	2	17	18	23	13	20	21	65	48	46	17	42	18	16	366
Barn Swallow	3	63	33	44	62	43	19	12	20	29	9	11	6	4	358
Fox Sparrow	7	18	32	19	33	25	19	36	15	9	19	35	18	40	325
Belted Kingfisher	20	19	20	23	32	23	22	21	30	28	21	11	11	18	299
Say's Phoebe	17	31	10	28	2	20	9	17	46	23	26	14	18	31	292
Wild Turkey		23	6	8	17	23	7	47	42	53	18	19	17	11	291
Downy Woodpecker	14	17	19	18	20	11	9	7	29	28	45	18	36	18	289
Wilson's Warbler		17	15	31	32	15	6	9	4	6	62	23	38	15	273
Red-tailed Hawk	11	16	31	24	19	12	16	19	19	19	16	21	24	22	269
Black-throated Sparrow	8	12	18	13	11	21	22	9	12	18	18	29	38	30	259
Turkey Vulture	23	19	21	11	31	13	19	10	14	18	8	33	17	13	250
Swainson's Thrush			15	18	2	22	18	28	9	36	27	28	21	19	243
Hairy Woodpecker	14	25	40	24	15	18	26	8	4	10	17	5	16	16	238
Gray Flycatcher			1	6		1		107	25	5	40	17	5	27	234
Killdeer	6	16	16	16	15	16	13	23	15	44	7	10	17	16	230
Cooper's Hawk	19	2	12	23	14	15	17	35	17	20	3	8	24	20	229
Northern Mockingbird	2	8	33	11	23	15	20	39	11	6	15		26	8	217
Franklin's Gull		60	35	30		2	48		4	19		17		1	216
California Gull			4	2	2	6	82	24	23	4	44	1	4	18	214
White-faced Ibis	4	55	21	24	1	1	4	41	19	2			15	12	199
Cassin's Kingbird		1	33	28	7	42	42	7	11	3	2	7	3	6	192
Lark Sparrow	12	17	9	14	6	8	4		10	4	73	9	11	7	184
White-crowned Sparrow	2	3	25	3	35	13	8	1	50	10	21	6	5	1	183
Gray Catbird	2	1		4	6	14	11	8	20	13	14	19	26	43	181
Townsend's Solitaire	9	12	8	19	8	19	14	3	2	8	29	14	15	18	178
Black Phoebe	3	17	18	14	14	28	18		13	13	14	7	7	11	177
Summer Tanager	5	2	7	19	14	15	10	25	29	16	8	7	4	10	171
American Crow	6	41	14	12	5	3	4	3	4	22	2	16	15	9	156
Mountain Bluebird	8	13	1	1	1	9	4	8	42	15	10	6	7	30	155
Common Yellowthroat	5	26	12	5	3	9	4	9	9	10	7	9	16	15	139
Great Blue Heron	3	10	5	17	13	4	3	16	14	11	7	4	11	19	137
American Dipper	2	2	3	8	3	5	10	12	13	12	19	12	19	10	130
Brewer's Sparrow	5			33	2	5	1	3	6		24	7	13	9	108
Red-breasted Nuthatch	11	6	18	6	13	6	4		2	2		19	12	7	106
Chukar		2	18	8	5		4	25	13	27	1	2			105

Common Name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
White-breasted Nuthatch	22	12	5	3	2	2	2	5	5	4	34		8	1	105
Juniper Titmouse	1		16	3	5	18	5	1		1	10	6	21	14	101
Sandhill Crane		9	1	5	9	6	9		6	11	3	17	15	2	93
Common Nighthawk	3	5	4	12	5	2	5	9	6	11	12	7	8		89
Red-naped Sapsucker	1	6	7	5	10	6	8	2	11	1	1	3	14	12	87
Double-crested Cormorant			7	9				21	3	12	7	20	4		83
Eastern Kingbird	5	15		2		1	5	6	13	16	11	3	6		83
Clark's Nutcracker	17	3	5	6	7	4	5	4	12	1		15		2	81
Golden Eagle		9	1	5	9	6	6	6	5	6	4	13	3	7	80
Hammond's Flycatcher				1		10	11	3	17	5	1	10	13	9	80
Rock Dove		3		9		3	7		8	13				35	78
American Coot				1	1			69		1	1		1		74
Lincoln's Sparrow	1		18	9	12	7	3	4	4	1		3	9	3	74
Olive-sided Flycatcher	5	2	8	6	1	6	5	6	9	4	1	3	7	7	70
Western Bluebird		1		2	4	4	2	6	22	2	9	8	5	3	68
Band-tailed Pigeon	9	1	6		29	16	5		1						67
Common Snipe	2	5	10	6	10	8	3	10		1				3	58
Peregrine Falcon		2	1	6	4	1	7	4	4	2	2	13	4	8	58
Sharp-shinned Hawk	4	3		2	3	10	12	1	2	1	3	4	7	6	58
Gambel's Quail				2				4	2				20	27	55
California Quail	4	4	22	7	2	4	6	2	1	2					54
Bank Swallow		27	10	3	5				1			2			48
Willow Flycatcher			9	3		2		12	6	1	3	2	4	6	48
Indigo Bunting			3			11	2	6	3	8	3	2	5	4	47
Golden-crowned Kinglet	1	5	5	2		1	1	1	2			14	8	3	43
Common Merganser				1	6	6	5	5	1	1	2	1	13		41
Swainson's Hawk			19	1		6	3	6	1				1	1	38
Great Horned Owl	1	2	2	3	7	2	3	2		2		4	5	2	35
Ruffed Grouse						1	2	6	5		2		16	1	33
Horned Lark								14	13	3	1			1	32
American White Pelican		10					1		2	1			16	1	31
Northern Harrier		1	1	1	3	1	4	5	2	2	1	3	3	4	31
Least Flycatcher					3	8	1	1	6	3	3		5		30
Rufous Hummingbird			1		1			17	4	1	2	2			28
Ladder-backed Woodpecker		2	4	2		5		1				1	10	2	27

Common Name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Cinnamon Teal				11	2	2		6		3			2		26
Black-crowned Night-Heron		4	2	9	1	5		2						1	24
Osprey		1		1	2	1	1	3			3	2	4	6	24
Vesper Sparrow		1				1	1	5	3	1	7	1	1	2	23
Sage Sparrow	1	2							4	8	6	1			22
Gray Vireo				2		6	1	1			4	2	1	4	21
Bell's Vireo			4	3			3		7		1			1	19
Black-chinned Sparrow					4						8	1		6	19
House Sparrow				1					5			5		7	18
Marsh Wren					1	6	1	1		3	2			3	17
Redhead		2	4		10			1							17
Forster's Tern	1		1	1	7		1			5					16
Long-eared Owl					8		2	1	2					2	15
Northern Pintail							1	12		1	1				15
Gray Jay						1		13							14
Phainopepla						6	1	1				6			14
Red Crossbill	1	9					1	1				1			13
Scott's Oriole		2	2	4		1					1		2		12
Grasshopper Sparrow	2	1		1	1						3		2	1	11
Northern Waterthrush						1	1	6		2		1			11
American Redstart					1		1	2	3				2	1	10
Gadwall	3		1	5		1									10
Lewis's Woodpecker					1			2		6					9
Sage Grouse		1									8				9
Snowy Egret			2						2	2				3	9
Western Grebe		1		1	1				2					4	9
Prairie Falcon	3				1	2	1	1							8
Three-toed Woodpecker								8							8
American Green-winged Teal				2				4		1					7
Loggerhead Shrike								1	2					4	7
Northern Goshawk		1		1	1	1	1			1				1	7
Cactus Wren				6											6
Evening Grosbeak				2		4									6
Hooded Oriole			1	4					1						6
Sage Thrasher					1	1			2			2			6

Common Name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Common Poorwill				1			3			1					5
Sora				1		2		1		1					5
Yellow-billed Cuckoo	2								1	1	1				5
Black Swift									4						4
Bohemian Waxwing			2					2							4
Caspian Tern				2						1				1	4
Cattle Egret			2				2								4
Common Grackle					2			2							4
Great Egret		1									3				4
Hepatic Tanager						3								1	4
White-throated Sparrow			3				1								4
Black-necked Stilt										3					3
Greater Roadrunner				1	1		1								3
Savannah Sparrow							1							2	3
Virginia Rail								2					1		3
Western Screech-Owl		1						2							3
American Tree Sparrow											2				2
Black Brant										2					2
Black-and-white Warbler					1		1								2
Brown Creeper													1	1	2
Brown Thrasher										2					2
Ferruginous Hawk									1			1			2
Pied-billed Grebe					1									1	2
Red-breasted Merganser								2							2
Rose-breasted Grosbeak								1						1	2
Solitary Sandpiper						1	1								2
Willet		1				1									2
Wood Duck				2											2
American Bittern				1											1
Barn Owl								1							1
Bendire's Thrasher								1							1
Blue Grouse								1							1
Calliope Hummingbird						1									1
Cassin's Vireo									1						1
Common Black-Hawk								1							1

Common Name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Hudsonian Godwit									1						1
Northern Parula										1					1
Northern Pygmy-Owl					1										1
Pygmy Nuthatch													1		1
White-eyed Vireo											1				1

TABLE 5. Total individuals observed, by species, during point transect surveys conducted at the 15 BLM survey sites from 1992 – 2005.

Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Spotted Towhee	114	264	295	372	305	271	296	798	674	402	325	342	428	508	5394
Yellow Warbler	41	107	220	176	136	171	171	488	414	267	235	172	294	429	3321
Ash-throated Flycatcher	95	153	135	143	110	130	132	61	179	189	223	237	336	274	2397
Mourning Dove	115	134	133	121	114	125	77	321	193	163	106	107	225	236	2170
Cliff Swallow	130	169	25	345	191	121	115	282	168	50	20	84	67	329	2096
Violet-green Swallow	44	119	56	338	52	165	68	58	88	86	288	102	144	128	1736
Blue-gray Gnatcatcher	65	104	65	103	48	82	87	56	68	158	161	114	214	287	1612
White-throated Swift	31	253	70	126	64	71	55		50	54	11	120	187	203	1295
Lazuli Bunting	110	149	54	60	49	80	104	68	34	115	57	112	55	209	1256
Plumbeous Vireo	63	91	74	114	85	84	64	24	43	77	106	109	141	164	1239
Yellow-breasted Chat	25	106	34	85	71	69	116	48	110	103	59	108	100	151	1185
Warbling Vireo	20	66	44	44	52	86	102	37	72	62	132	108	145	198	1168
American Robin	14	62	74	101	66	55	48	271	144	90	49	43	39	67	1123
Lesser Goldfinch	67	162	69	117	51	137	55	47	20	51	10	35	79	199	1099
Brown-headed Cowbird	26	55	69	75	59	75	61	69	101	53	85	30	91	87	936
Rock Wren	45	75	33	57	18	41	27	258	63	43	13	45	92	92	902
House Finch	23	11	26	64	28	5	16	61	223	19	36	42	189	157	900
Bushtit	35	36	79	8	36	28	49	84	194	19	27	40	28	65	728
Bewick's Wren	5	27	44	28	22	52	57	13	30	14	52	81	135	138	698
Common Raven	7	36	43	37	31	23	36	82	74	47	42	57	40	105	660
Western Wood-Pewee	20	26	10	14	9	14	38	151	108	16	19	26	61	52	564
Red-shafted Flicker	4	38	53	57	42	19	29	40	135	27	36	7	37	38	562
N. Rough-winged Swallow	1	81	65	193	22	27	6	1	2	3	9	2	23	89	524
Cassin's Finch		10	6	15	9	62	10	349	18	7	6	3	3	7	505
Lucy's Warbler	5	37	54	57	22	38	21	89	39	10	24	12	18	51	477
Canyon Wren	16	20	30	24	27	28	34	132	38	15	12	14	38	33	461
Black-headed Grosbeak	9	42	55	58	21	25	41	12	8	28	26	43	34	35	437
Bullock's Oriole	13	46	26	49	27	24	24	27	27	32	55	26	17	36	429
Pinyon Jay		1	32	10	14		52	172	66	20	51	7	2		427
Blue Grosbeak	21	28	14	30	11	32	47	33	16	26	15	53	55	23	404
Tree Swallow	11	3	42	2	35	1	20	161	116		4	3			398

Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Audubon's Warbler		36	33	29	19	10	11		115	6	24	14	29	46	372
Western Tanager	3	22	21	21	10	9	17	19	65	29	27	23	46	55	367
Song Sparrow	4	14	8	13	29	5	15	96	61	18	28	16	17	31	355
Virginia's Warbler	3	28	15	16	6	17	23	74	44	51	22	5	29	16	349
Broad-tailed Hummingbird	23	60	29	48	25	8	13	2	27	23	11	8	30	39	346
Black-chinned Hummingbird	5	33	16	27	20	24	11	69	36	36	4	5	16	32	334
Western Kingbird	1	18	17	10	10	8	6	51	49	50	16	22	30	45	333
Chipping Sparrow	7	24	25	16	40	27	34	14	15	19	13	16	25	53	328
House Wren	30	34	8	25	10	12	18	64	9	14	4	18	12	30	288
Black-throated Gray Warbler	15	16	18	15	4	21	27	15	21	12	22	16	33	48	283
American Goldfinch	28	59	29	35	15	15	10	10	5	7	11	15	8	26	273
Western Scrub-Jay	4	1	11	24	18	23	42	2	14	6	42	25	31	25	268
Say's Phoebe	16	24	7	19	2	19	6	5	43	13	19	11	15	31	230
Black-throated Sparrow	8	7	16	7	9	19	21	7	7	11	14	29	33	22	210
Northern Mockingbird	2	8	33	11	22	14	19	27	11	6	15		22	8	198
Pine Siskin	15	33				19	5	10	3		3			102	190
Red-winged Blackbird	3	18	11	11	8	13	4	2	12	13	24	10	28	24	181
Cassin's Kingbird			30	27	7	40	38	5	11	3	2	7	3	6	179
Mallard	1	13	17	21	15	5	4	30	16	22	4	4	4	19	175
Black Phoebe	3	17	18	14	14	28	17		13	13	14	7	6	9	173
MacGillivray's Warbler	1	1	9	6	1	7	14	2	64	3	21	7	13	21	170
Gray Flycatcher			1	2		1		91	20	2	25	11	3	13	169
Wild Turkey		23	5	6	15	23	7	19	10	27	9	7	9	7	167
Black-billed Magpie	9	54	13	20	8	8	13	7	15	4	1	5	8	1	166
Summer Tanager	5	1	7	19	14	13	10	23	28	16	8	7	4	10	165
European Starling		24	17	33	14	11	10	7	2	11	1	8	1	5	144
Cooper's Hawk	10		4	10	5	10	11	27	10	9	2	4	22	15	139
American Crow	5	39	8	12	5	2	3		4	17	2	15	13	5	130
Spotted Sandpiper	6	25	10	8	9	4	9	6	8	11	8	8		12	124
Black-capped Chickadee	10	17	7	26	5	4	6	8	8	5		4	4	18	122
Lark Sparrow	10	8	7	14	4	7	3		6	2	46	5	5	5	122
American Kestrel	8	19	7	11	8	14	17	6	9	6	5	5	5	1	121
Hairy Woodpecker	3	11	15	10	9	7	6	2	2	6	9	4	10	14	108
Brewer's Blackbird	2	15	31	24	14	2	1			12				5	106
White-crowned Sparrow	2	3	12	3	21	5	6	1	27	3	15	2	3		103

Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Wilson's Warbler		8	10	8	3	3					25	8	29	9	103
Ring-necked Pheasant	2	6	14	2	5	15	2	16	10	5	1	13		5	96
Mountain Bluebird		12		1		8	2		22	5	2	4	4	20	80
Green-tailed Towhee	6	9	3	11	4	2	3		2	7	16	6	8	2	79
Turkey Vulture		9	17	6	6	7		2	1	6	1	10	1	6	72
Brewer's Sparrow	1			31		1					13	3	10	8	67
Red-tailed Hawk		2	3	5	3	3	3	9	4	6	2	4	9	13	66
Canada Goose		9	11	26	2	4			1	7			2		62
Chukar		1	7		3		2	25	8	16					62
Juniper Titmouse			3	2	4	16	4	1		1	3	4	18	5	61
Western Bluebird		1		2	4	4	2	6	21	2	4	6	5	3	60
Mountain Chickadee		6	6	4	5		12	13		1		3	7	2	59
Belted Kingfisher	2	2	12	3	10	7	7	5	3	1				2	54
Killdeer	2	1	3	5	3	4	2	4	1	9	1		12	6	53
Gambel's Quail				2				4	2				17	27	52
Dusky Flycatcher		2				3	13	3	1	1	16	4	5	1	49
Great Blue Heron		3	1	4	3	2		2	2	3	5	1	7	11	44
California Quail	4	3	11	6	2	4	6	1		2					39
Common Nighthawk				2		2	3	8	5	3	9	2	4		38
Common Yellowthroat		3	3			3	3		2	1	1	5	7	10	38
Barn Swallow				2		28							3		33
Downy Woodpecker	2	2		8					7	1	3		5	4	32
Orange-crowned Warbler			1		2	1	2		1	1	3		12	9	32
Indigo Bunting						5	2	3		7	3	2	5	4	31
Hermit Thrush				2		1	3		1				10	11	28
Ladder-backed Woodpecker		2	4	2		5		1				1	10	2	27
Cordilleran Flycatcher	1			3		4				4	1		12	1	26
Horned Lark								11	10	3	1				25
Ruby-crowned Kinglet		2	2	4	6					2		2	3	3	24
Cedar Waxwing	3	4		7		2		4	1			1			22
Rufous Hummingbird								17	4						21
House Sparrow				1					5			5		7	18
Black-chinned Sparrow					4						8			5	17
Sharp-shinned Hawk	4	2			1	4	3				1			2	17
Golden Eagle				1	1		2	2	4			3		3	16

Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Dark-eyed Junco				3				3	9		1				16
Western Meadowlark		1		10	2			3							16
Great Horned Owl		1	1		2	2	2			2		2	3		15
Long-eared Owl					8		2	1	2					2	15
Gray Vireo				1		6	1	1					1	4	14
Peregrine Falcon				2	2	1	4	1	4						14
Townsend's Solitaire			2	3	1			1			2	1		4	14
Willow Flycatcher			2						3		2	1	3	3	14
Bell's Vireo			4	2			3		3					1	13
Red-breasted Nuthatch	2	3	5		1									2	13
Olive-sided Flycatcher			3				3		2					4	12
Grasshopper Sparrow	2			1							3		2	1	9
Common Merganser				1	3		2			1					7
Double-crested Cormorant									1	1	1	4			7
Lincoln's Sparrow			3		2				1	1					7
Sage Grouse											7				7
Sage Sparrow		2								2	2	1			7
Steller's Jay		2	2	1						1				1	7
Hooded Oriole			1	4					1						6
Rock Dove		3		3											6
Band-tailed Pigeon							5								5
Bank Swallow			3									2			5
Cactus Wren				5											5
Gray Catbird						2							2	1	5
Phainopepla												5			5
Scott's Oriole			2								1		2		5
White-breasted Nuthatch		2		2									1		5
Yellow-headed Blackbird					2							1		2	5
American Dipper						1		3							4
Black Swift									4						4
Great Egret		1									3				4
Northern Harrier							3			1					4
Swainson's Thrush				1	1								2		4
Vesper Sparrow						1		1			1			1	4
American Coot										1	1		1		3

Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Black-crowned Night-Heron		1	1					1							3
Clark's Nutcracker									1					2	3
Golden-crowned Kinglet			1									2			3
Hepatic Tanager						3									3
Prairie Falcon					1	1	1								3
Ruffed Grouse								3							3
Savannah Sparrow							1							2	3
California Gull							2								2
Cinnamon Teal					2										2
Evening Grosbeak						2									2
Ferruginous Hawk									1			1			2
Fox Sparrow					2										2
Loggerhead Shrike									2						2
Red-naped Sapsucker					1							1			2
Snowy Egret									2						2
Western Screech-Owl								2							2
Am.Green-winged Teal										1					1
Barn Owl								1							1
Common Black-Hawk								1							1
Common Poorwill				1											1
Eastern Kingbird									1						1
Hammond's Flycatcher									1						1
Hudsonian Godwit									1						1
Northern Goshawk				1											1
Northern Waterthrush						1									1
Rose-breasted Grosbeak														1	1
Sage Thrasher					1										1
Virginia Rail													1		1
White-eyed Vireo											1				1

TABLE 6. Total individuals observed, by species, during point transect surveys conducted at the 13 USFS survey sites
from 1992 – 2005.

Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
American Robin	151	359	351	362	403	269	253	584	537	414	407	249	378	383	5100
Yellow Warbler	59	251	285	198	231	213	191	519	563	457	445	247	408	359	4426
Warbling Vireo	118	360	272	214	196	287	335	203	282	244	328	363	440	431	4073
Spotted Towhee	101	166	297	238	199	177	200	519	373	243	394	209	287	193	3596
Broad-tailed Hummingbird	110	196	153	154	100	96	109	43	95	98	117	72	61	185	1589
Violet-green Swallow	72	154	66	87	126	131	297	49	48	114	21	121	113	161	1560
Song Sparrow	18	60	68	90	105	84	89	218	69	73	143	69	145	143	1374
Lazuli Bunting	58	143	62	89	95	64	81	71	28	94	102	95	150	119	1251
Chipping Sparrow	69	63	65	71	59	88	76	37	109	76	60	80	162	112	1127
Western Tanager	24	56	61	45	29	60	85	66	89	83	54	171	88	102	1013
Mourning Dove	22	48	147	18	80	28	37	106	132	65	118	52	123	32	1008
Hermit Thrush	49	76	80	84	80	69	67	43	109	76	46	50	102	40	971
Pine Siskin	31	64	53	43	36	81	40	97	166	56	155	23	48	64	957
MacGillivray's Warbler	31	58	57	30	44	56	67	46	81	63	102	82	96	127	940
Plumbeous Vireo	43	91	79	62	73	73	64	26	34	50	115	74	83	68	935
House Wren	41	111	131	103	90	65	79	26	35	22	12	47	66	79	907
Cassin's Finch	33	61	29	84	53	36	28	285	50	66	60	13	33	27	858
Black-capped Chickadee	32	40	50	60	65	16	29	31	77	97	99	34	117	80	827
Mountain Chickadee	64	41	67	94	40	37	29	12	46	30	26	91	112	86	775
Black-headed Grosbeak	21	46	55	61	31	45	66	23	39	42	93	73	92	54	741
Dusky Flycatcher	38	11	44	24	37	99	82	45	50	54	30	80	73	59	726
Red-shafted Flicker	15	55	61	67	57	27	52	55	125	65	52	31	35	27	724
Virginia's Warbler	30	17	50	21	36	41	38	20	55	139	34	61	109	72	723
White-throated Swift	17	70	39	48	101	38	76	51	114	26	28	16	31	46	701
Audubon's Warbler	4	10	55	32	20	21	56	18	39	20	149	61	29	93	607
Dark-eyed Junco		14	5	18	10	12	15	134	105	33	92	20	69	48	575
Green-tailed Towhee	42	66	48	36	51	36	40	23	32	39	14	37	31	32	527
Brown-headed Cowbird	19	7	7	26	15	41	41	35	41	37	61	25	41	68	464
Pinyon Jay	5		9	7		4		163	91	44	40	82	13		458
Western Wood-Pewee	67	31	23	23	28	35	20	30	16	64	33	17	31	24	442
Ruby-crowned Kinglet	5	42	36	62	25	20	11	15	13	16	10	54	55	73	437

Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Tree Swallow	103	22	39	13	15	12	28	22	62	54	45	9	1	2	427
Black-billed Magpie	16	37	38	42	42	27	20	27	35	19	23	30	35	33	424
American Goldfinch	19	52	50	41	32	22	21	18	27	15	25	28	43	22	415
Black-throated Gray Warbler	10	5	9	22	3	17	16	5	48	28	64	33	53	50	363
Common Raven	2	4	11	6	14	6	5	35	65	25	63	19	38	26	319
Yellow-breasted Chat	8	33	9	16	21	17	8	8	34	33	33	24	42	31	317
Steller's Jay	2	14	16	22	10	16	20	59	48	26	12	40	15	15	315
Cordilleran Flycatcher	15	16	9	11	1	8	23	10	27	5	8	19	65	87	304
Bushtit	20	3	2	5	2		8		74	16	56	33	14	19	252
House Finch	7	6	5	1	10	4	2	74	115	8	1	1	2		236
Cliff Swallow	12	4		3	2	16	2	41	43	47	62		1		233
Orange-crowned Warbler	3	2	22	7	8	12	20	19	4	31	22	22	27	21	220
Canyon Wren	16	9	4	7	10	21	14	38	22	14	14	14	14	22	219
Black-chinned Hummingbird		3	2	6	15	3	11	50	32	4	6	3	53	20	208
Rock Wren	20	19	19	4	8	6	11	30	19	4	19	9	21	7	196
Swainson's Thrush			10	16	1	16	11	17	2	29	26	19	18	14	179
Spotted Sandpiper	29	15	5	20	14	13	10	4	8	14	20	7	11	5	175
Blue-gray Gnatcatcher	3	9	7	10	3	3	7		8	15	52	12	17	18	164
American Kestrel	4	10	19	4	8	9	6	9	20	10	11	18	17	12	157
Fox Sparrow	5	16	25	8	12	7	6	12	4	5	6	22	8	16	152
European Starling		10	3	35	30	6	7	8	6	8	4	6	17	7	147
Lesser Goldfinch	7	32	5	5	6	17	12	41	5		3	5		2	140
Belted Kingfisher	12	16	7	12	15	9	9	6	14	6	11	6	8	2	133
Western Scrub-Jay	23	12	11	14	9	9	8	5	11	5	5	6	8	7	133
Townsend's Solitaire	7	9	6	7	6	15	14	2	2	8	17	11	13	14	131
N. Rough-winged Swallow		26	15	13	4	4	8	3	6	12		1	2	30	124
Cedar Waxwing	12	23	3	22	9	8	4	4	10	7	1	1	4	15	123
Red-tailed Hawk	9	8	11	12	5	5	6	5	6	10	12	12	13	6	120
Downy Woodpecker	7	8	5		8	3	2	3	12	9	24	11	13	8	113
Mallard		12	11	10	7	23	6	10	3	3	5	1	7	14	112
American Dipper	2	1	2	5	2	4	9	6	10	10	15	10	12	8	96
Turkey Vulture	20	4	3	1	10	2	15		10	3	7	11	2	2	90
White-breasted Nuthatch	20	10	5	1	2	2	2	1	3	3	33		7	1	90
Bullock's Oriole		4	1	2	5	2	2	8	6	8	20	19	7	1	85
Hairy Woodpecker	9	13	14	9	3	8	8	2	1	2	8	1	2	2	82

Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Wilson's Warbler		8	4	6	8	2	4	6	2	5	19	10	3	4	81
Mountain Bluebird	8	1	1		1	1	2	8	17	10	8	2	3	9	71
Red-naped Sapsucker	1	6	7	5	6	6	7	2	5		1	2	13	10	71
Clark's Nutcracker	17	3	5	6	7	4	5	4	6	1		12			70
Hammond's Flycatcher				1		10	11	3	13	4	1	10	7	9	69
California Gull								20		2	39			5	66
Lucy's Warbler		2		5				53	1						61
Gray Catbird	2	1		1	3	6	4		1	6	4	4	11	15	58
Red-breasted Nuthatch	5	2	8	3	8	5	3			1		19	1	3	58
Lincoln's Sparrow	1		8	9	10	6	3	4	3			1	9	3	57
Wild Turkey					2			18	7	9	7	7	2		52
Golden Eagle		5	1	2	6	5	2	3	1	4	3	7	3	4	46
Olive-sided Flycatcher	4		4	4	1	6	2	5	4	4		3	6		43
Lark Sparrow	2	6	2		1	1	1		1	2	18	1	5		40
Peregrine Falcon				3	2		2	2		2	2	13	4	8	38
Cooper's Hawk	4	2	1	9	3	2	2	5	3	2		1		2	36
Rock Dove														35	35
Ash-throated Flycatcher		4	3	5		4	4	2	1	2	4	4			33
Bewick's Wren		5	18	1	2	2	1				2	1			32
Gray Flycatcher				4				2	5	3	7	6	2	3	32
Juniper Titmouse	1		12	1	1	1	1				4	2	2	6	31
Golden-crowned Kinglet	1	5	3	2		1	1	1	2			8	6		30
White-crowned Sparrow			3		4	1	1		11	6	3			1	30
Blue Grosbeak			1	1	1		3	2	14	1	1			4	28
Sharp-shinned Hawk		1		2	1	6	7	1	1			4	4	1	28
Ruffed Grouse						1	2	3	5		2		10	1	24
Brewer's Sparrow	4			1	2	3	1		5		4	1			21
Brewer's Blackbird			4	6	9			1							20
Common Nighthawk	2	5	3	4	3					1			1		19
Western Kingbird		1	1	1				7		3		4			17
Great Blue Heron	2	4		2			1		3		2			1	15
Northern Harrier		1	1	1		1	1	2					2	4	13
Say's Phoebe		2		4				1			3	1	2		13
Common Yellowthroat	1	1	1	1	1	1			6						12
Vesper Sparrow		1					1		2		6	1	1		12

Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Black-throated Sparrow		3								6	2				11
Gray Jay						1		10							11
Sage Sparrow									4	6	1				11
American Crow			2				1			1		1	1	4	10
American White Pelican													10		10
Killdeer		1	2		2	1		4							10
Bank Swallow		6	3												9
Barn Swallow		5			2				1						8
California Quail		1	5	1					1						8
Red-winged Blackbird		1			1	2		2	1				1		8
Three-toed Woodpecker								8							8
Western Meadowlark			1	1	2	1	1						1	1	8
Gray Vireo				1							4	2			7
Northern Waterthrush							1	4		2					7
Red Crossbill	1	4						1				1			7
Rufous Hummingbird			1		1					1	2	2			7
Common Merganser							1	4	1						6
Lewis's Woodpecker										6					6
American Redstart							1		3						4
Great Horned Owl		1	1											2	4
Prairie Falcon	3					1									4
Ring-necked Pheasant		1											3		4
Northern Goshawk						1	1							1	3
Northern Mockingbird						1	1						1		3
Swainson's Hawk						2								1	3
American Tree Sparrow											2				2
Black-and-white Warbler					1		1								2
Brown Creeper													1	1	2
Evening Grosbeak				2											2
Grasshopper Sparrow		1			1										2
Indigo Bunting			2												2
Red-breasted Merganser								2							2
Sage Grouse		1									1				2
Virginia Rail								2							2
Western Bluebird											2				2

Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Willow Flycatcher						1						1			2
Bell's Vireo									1						1
Bendire's Thrasher								1							1
Black Phoebe							1								1
Blue Grouse								1							1
Brown Thrasher										1					1
Cactus Wren				1											1
Calliope Hummingbird						1									1
Cassin's Vireo									1						1
Gambel's Quail													1		1
Hepatic Tanager														1	1
Osprey					1										1
Sage Thrasher												1			1
Scott's Oriole						1									1
Western Grebe		1													1
White-throated Sparrow							1								1

TABLE 7. Total numbers of individuals observed, by species, during point transect surveys conducted at the 2 USFWS survey sites from 1992 – 2005.

Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Yellow Warbler	21	23	106	91	97	54	67	256	91	302	156	62	209	159	1694
American Robin	24	95	88	142	46	33	64	32	84	107	56	20	35	52	878
Mourning Dove	25	25	96	101	31	28	24	136	48	83	63	15	53	39	767
Brown-headed Cowbird	12	49	44	48	25	38	40	147	61	114	75	15	36	53	757
American Goldfinch	32	59	93	81	44	38	38	34	73	57	28	13	32	53	675
Spotted Towhee	6	5	34	38	45	17	13	63	43	101	126	17	68	24	600
House Wren	37	19	84	108	42	14	27	16	17	39	16	25	62	36	542
Black-headed Grosbeak	13	15	52	51	34	24	29	40	38	43	40	27	43	32	481
Red-winged Blackbird	1	30	33	50	28	24	12	176	19	62	11	7	7	11	471
Bullock's Oriole	10	25	47	42	16	18	26	24	33	94	24	21	20	35	435
Ring-necked Pheasant	6	22	39	44	32	24	9	77	33	55	35	9	17	23	425
Song Sparrow	7	18	23	44	12	29	33	66	30	51	36	12	25	16	402
Western Meadowlark	10	35	44	56	14	10	10	29	9	23	21	3	18	18	300
Lazuli Bunting	10	30	52	21	10	10	26	15	10	12	12	21	22	24	275
Western Wood-Pewee	22	3	29	13	5	7	8	13	13	39	26	13	48	16	255
Warbling Vireo		9	15	10	8	5	10	16	7	75	48	10	24	4	241
Black-billed Magpie	5	16	38	26	14	16	13	15	23	40	14	4	6	9	239
Yellow-breasted Chat	6	8	34	30	20	11	10	10	8	22	27	14	17	19	236
Yellow-headed Blackbird	2	5	15	8		4	2	114	5	37	8	3	1	5	209
Black-capped Chickadee	11	5	33	20	7	13	13	7	26	22	15	1	17	17	207
Audubon's Warbler			17	17	11	2	2		4	12	54	6	4	5	134
Mallard		2	9	16	14	6	16	38	5	10	11		1	2	130
Plumbeous Vireo	1		11	24	6	2	5	3	4	8	19	10	29	5	127
Red-shafted Flicker	8	2	12	17	11	3	4	18	6	9	6	1	3	3	103
Western Kingbird	5	2	5	9	4	3	2	7	12	18	10	2	15	5	99
Canada Goose		1	6	12	11	5	1	9	3	7	14	2	10	10	91
Barn Swallow	3	16	11	5	5	4	6	1	8	13	5	2		1	80
Killdeer	1	1	5	6	5	8	6	9	7	20	3	2	3	3	79
Eastern Kingbird	3	10		2		1	4	5	11	16	11	3	6		72
American Coot				1	1			69							71
Brewer's Blackbird	1	4	22	11	12	2	2	1	2	1	3	6	1		68

Orange-crowned Warbler	1	4	6	2	1	1	1			19	32				67
Blue-gray Gnatcatcher	1	7		5					6	5	5		14	19	62
Virginia's Warbler			1		3		2		2	50		1	1		60
N. Rough-winged Swallow		6	10	15		9	7	2	3	2		1	1	3	59
Common Yellowthroat	3	20	8	3		4	1	6	1	4	3		1	1	55
MacGillivray's Warbler		1	11	2	1	2	5	7		5	10	4	4		52
Spotted Sandpiper	3	6	5	6		2				12	7	5	3	3	52
Double-crested Cormorant			5	8				14	2	6	6	2	2		45
White-faced Ibis	3	8	8	9	1	1	4	2	4	1			2	1	44
European Starling	2	2		8	2	5	4		3	9	5		3		43
Franklin's Gull		11	8	9		1	2		2	2		5		1	41
Great Blue Heron	1	2	2	4	6	2		5	8	4		2	3		39
Tree Swallow			1	1			5	11	4	11	6				39
Cassin's Finch			1					20			15				36
Downy Woodpecker	2	1	7	4	2	1		1	5	5	1		4		33
Cedar Waxwing	1	4	1	1				1	3	13	3	2			29
Sandhill Crane		6	1	3	3	4	3		3	5				1	29
Swainson's Hawk			16	1		2	3	5	1						28
Lesser Goldfinch	1	6	1	1		2		11		4			1		27
Common Raven	2	2	2	2	1	1		8	2	1	3	1	1		26
Willow Flycatcher			6	3				10		1	1		1	3	25
Gray Catbird						2		2	3		2	4	2	8	23
House Finch	1	2	4	1	3	3	3	2			1		2		22
Red-tailed Hawk		2	5	2	5	1	2			2			1	2	22
Dusky Flycatcher			1		2		2	2		1	7		6		21
Bank Swallow		14	3	1	2										20
Western Tanager			4	4	2			2		3	2		2	1	20
Least Flycatcher						2			6	3	3		5		19
Cooper's Hawk	2		4	3	2		2	1		4					18
Wilson's Warbler				2	8	2	2				3	1			18
Bushtit										5	12				17
California Gull			2	1	2		4		2	2	3		1		17
Say's Phoebe		1						10		5			1		17
Violet-green Swallow	4	1	5			5	2								17
Black-crowned Night-Heron		3	1	6	1	3		1						1	16
Blue Grosbeak	2	3	1		1	1	5	1		1				1	16

Broad-tailed Hummingbird				3					4	6		1	2	16
Common Snipe		1	5		2	6	1	1						16
Green-tailed Towhee				2	3		3	1		5			2	16
Fox Sparrow							2		2	2	4		2	12
Great Horned Owl	1			2	4		1	1			1	2		12
Gray Flycatcher								2					9	11
Ash-throated Flycatcher				4					1	5				10
Cinnamon Teal				5		1		3	1					10
American Kestrel	2	1	2	1		1			2					9
Northern Harrier					3			3	1	1		1		9
American White Pelican		3					1		1			1	1	8
Forster's Tern	1		1	1	1				3					7
Marsh Wren						2			3	2				7
White-crowned Sparrow			4			3								7
Wild Turkey			1	2								1	3	7
Northern Pintail							1	3	1	1				6
Rock Dove				1		1	2		1	1				6
Gadwall	1		1	3										5
Hairy Woodpecker	1						4							5
Lark Sparrow										3		1	1	5
Lucy's Warbler								5						5
Snowy Egret			2						2				1	5
Turkey Vulture		1				1		3						5
Yellow-billed Cuckoo	2								1	1	1			5
Belted Kingfisher			1			1	1	1						4
California Quail			3					1						4
Cliff Swallow		2	1	1										4
Cordilleran Flycatcher		1				1						2		4
Olive-sided Flycatcher			1						3					4
Ruby-crowned Kinglet			1	1						2				4
Sharp-shinned Hawk										2		1	1	4
Sora				1		2		1						4
Townsend's Solitaire						2				2				4
Cattle Egret			1				2							3
Common Nighthawk	1			2										3
Hermit Thrush					1		1			1				3

Lewis's Woodpecker				1		2				3
Red-breasted Nuthatch			1		1				1	3
Redhead	1	1				1				3
Sage Thrasher					1		2			3
American Crow		1			1					2
American Green-winged Teal			1			1				2
Bewick's Wren								2		2
Black-throated Gray Warbler			1					1		2
Caspian Tern			1						1	2
Cassin's Kingbird	1					1				2
Chipping Sparrow					2					2
Common Grackle						2				2
Lincoln's Sparrow		2								2
Willet	1				1					2
American Bittern			1							1
Bell's Vireo			1							1
Black-necked Stilt								1		1
Brewer's Sparrow							1			1
Common Merganser								1		1
Dark-eyed Junco			1							1
Golden Eagle				1						1
Hammond's Flycatcher								1		1
Horned Lark									1	1
Juniper Titmouse		1								1
Loggerhead Shrike						1				1
Osprey						1				1
Peregrine Falcon					1					1
Pied-billed Grebe									1	1
Pine Siskin			1							1
Rose-breasted Grosbeak						1				1
Dark-eyed Junco			1							1
Vesper Sparrow								1		1
Wood Duck			1							1

TABLE 8. Total numbers of individuals observed, by species, during point transect surveys conducted at the 2 NPS survey sites from 1992 – 2005.

Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
American Robin	16	137	75	75	46	38	30	93	63	40	11	16	24	34	698
Yellow Warbler		33	23	31	19	19	15	90	40	21	19	15	28	46	399
Spotted Towhee	1	16	12	15	11	8	20	136	32	16	13	1	9	19	309
Yellow-breasted Chat	3	16	11	22	16	23	10	13	22	15	8	17	17	17	210
Bullock's Oriole	2	26	31	27	18	25	8	11	8	8	11	11	2	13	201
Ash-throated Flycatcher	4	24	4	24	22	4	6		13	25	13	16	19	22	196
Violet-green Swallow	11	33	15	21	3	17	10	3	13	13	11	9	13	12	184
Mourning Dove	8	6	5	6	10	7	8	58	11	12	6	1	4	7	149
White-throated Swift	15	33	6	20	9	12	10	4	7	7	2	7	3	10	145
Lazuli Bunting	7	32	6	14	8	15	14	9	3	8	4	12		12	144
Warbling Vireo	1	22	12	21	12	21	7	7	7	1	6	10	6	9	142
Black-headed Grosbeak	2	20	15	35	20	14	5	1	8	5		5	8	3	141
Brown-headed Cowbird	4	28	4	11	8	6	3	18	13	16	1		9	10	131
Rock Wren	8	11	2	5	3	2	2	39	6	7	5		2	9	101
Cassin's Finch			1			8	1	82	1		1				94
Black-chinned Hummingbird		5	7	9	14	12	6	19	3	5		4	2	4	90
Song Sparrow		7	10	7	4		9	25	14	5		1		5	87
Western Wood-Pewee	1	4	8	3	5	8	1	24	4	15	2		6	6	87
House Finch	2	8	8	2	6	1	4	28	17	4	2	1	3		86
Lesser Goldfinch		4	9	9	2	5	10	2		6	1		10	21	79
Canyon Wren	3	8	2	1	2	2	3	21	6	5	3		2	8	66
Western Tanager	1	5	4	5	8		2		13	3	2	1	12	8	64
Common Raven	2	4	4	5	3	5	4	21	3	3	2	1	2	2	61
Red-shafted Flicker		7	8	12	4	5	1	9	6	3	2	1	1		59
Blue-gray Gnatcatcher		4	2	2	1	3	1	2	2	8	6	2	8	17	58
Broad-tailed Hummingbird	1	11	7	9	5		3		1	9	1	1	4	6	58
Western Kingbird		2	4	2	4	5	5	7	12	2	4	2	2	2	53
Plumbeous Vireo	2	9	3	4	2	6	2			6	4	1	2	10	51
Blue Grosbeak	2	7	4	4		1				3	1	4	3	2	31
Brewer's Blackbird		4	13	7	3		1			3					31
MacGillivray's Warbler	1		2	1	1	2			15	1	3		2	3	31

Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Bewick's Wren		3	1		1	1		1	2	1	7	1	3	9	30
Black-throated Sparrow		2	2	3	1	2	1	2	4	1	1		4	7	30
Audubon's Warbler		1	1	1	2	1	3		16		2				27
Wilson's Warbler		1	1	9	7	1				1	3		2	2	27
Black-throated Gray Warbler	2	4			4	1	2			3	1	2	1	3	23
Chukar		1	3	6	1		1		5	3	1	2			23
House Wren				1		3		18						1	23
Say's Phoebe	1	4	2	3		1	3		3	1	3	2			23
Lucy's Warbler		3	1					2	11	1		2		2	22
White-crowned Sparrow			1		7				12			1	1		22
Spotted Sandpiper	7			4	4	1				3	1			1	21
Bushtit		1		3	1	1	3	1	7		1		1	1	20
Band-tailed Pigeon	2	1	2		7	6			1						19
American Goldfinch		4	1	4	1	2				3		2	1		18
N. Rough-winged Swallow		4		2	2	1	1				3	1	2	1	17
Tree Swallow		2	9		4				1						16
Hairy Woodpecker			8	1		2	2			2					15
Gray Flycatcher								7			7				14
Indigo Bunting			1			6		3	3	1					14
Cliff Swallow					3			10							13
American Kestrel	1	1		2	3	2			2	1					12
European Starling			1	1	2		1			7					12
Northern Mockingbird					1			11							12
Mallard			3	1	2	3		1				1			11
Virginia's Warbler	1					1	1	1		3	4				11
Cassin's Kingbird			2	1		2	3	1							9
Chipping Sparrow		1		1	1						3	1	1	1	9
Golden Eagle		3		1		1	1	1		1	1				9
Phainopepla						6	1	1				1			9
Green-tailed Towhee			1		2						4	1			8
Pinyon Jay							1	4					2	1	8
Belted Kingfisher	1			1						1				4	7
Common Yellowthroat	1	1		1						2			2		7
Cooper's Hawk								2	3	1			1		7
Cordilleran Flycatcher					3	3				1					7

Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Pine Siskin		1				2		1			2			1	7
Barn Swallow					1			1					2	2	6
Scott's Oriole		2		4											6
Western Scrub-Jay						1	1		2		2				6
American Crow	1	2								1			1		5
Common Merganser					1	2						1	1		5
Downy Woodpecker			3						1					1	5
Horned Lark								3	2						5
Orange-crowned Warbler				1									2	2	5
Peregrine Falcon		2	1	1				1							5
Summer Tanager		1				1		2	1						5
Bell's Vireo									3		1				4
Dusky Flycatcher				1							2	1			4
Gray Catbird				1		1	2								4
Killdeer		1			1		1			1					4
Olive-sided Flycatcher		2												2	4
Osprey		1		1	1		1								4
Greater Roadrunner				1	1		1								3
Western Meadowlark							1		2						3
Black Brant										2					2
Black Phoebe													1	1	2
Black-capped Chickadee														2	2
Brewer's Sparrow												1		1	2
Cedar Waxwing	1			1											2
Hermit Thrush				1	1										2
Juniper Titmouse													1	1	2
Lark Sparrow									2						2
Red-tailed Hawk			1	1											2
White-throated Sparrow			2												2
American Dipper			1												1
American Redstart					1										1
Bank Swallow									1						1
Black-chinned Sparrow														1	1
Brown Thrasher										1					1
Evening Grosbeak						1									1

Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Great Blue Heron								1							1
Lincoln's Sparrow			1												1
Mountain Chickadee											1				1
Northern Parula										1					1
Pygmy Nuthatch													1		1
Red-breasted Nuthatch			1												1
Ruby-crowned Kinglet				1											1
Sharp-shinned Hawk							1								1
Townsend's Solitaire				1											1
Vesper Sparrow														1	1
Western Bluebird									1						1
Willow Flycatcher						1									1

No formal inferential significance is yet applied to these trend data. A more comprehensive and robust re-analysis is called for, but despite the ad hoc approach applied here (annual site means during pre- and post-laser rangefinder periods were transformed to improve normality, standardized to a mean of 0, and a simple linear regression applied) the authors have confidence the full reanalysis will support these preliminary results. The addition of laser rangefinders to our survey methodology revealed a four-fold average difference in estimated bird abundances pre- and post- laser rangefinders (1999), with the likeliest scenario being a chronic over-estimation of distances (by approximately 15%) when rangefinders were unavailable as a correction standard.

BLM Survey Sites A total of 46,532 birds representing 166 species were recorded at BLM survey sites between 1992 and 2005 for an average of 3,324 birds per year and 98.4 birds

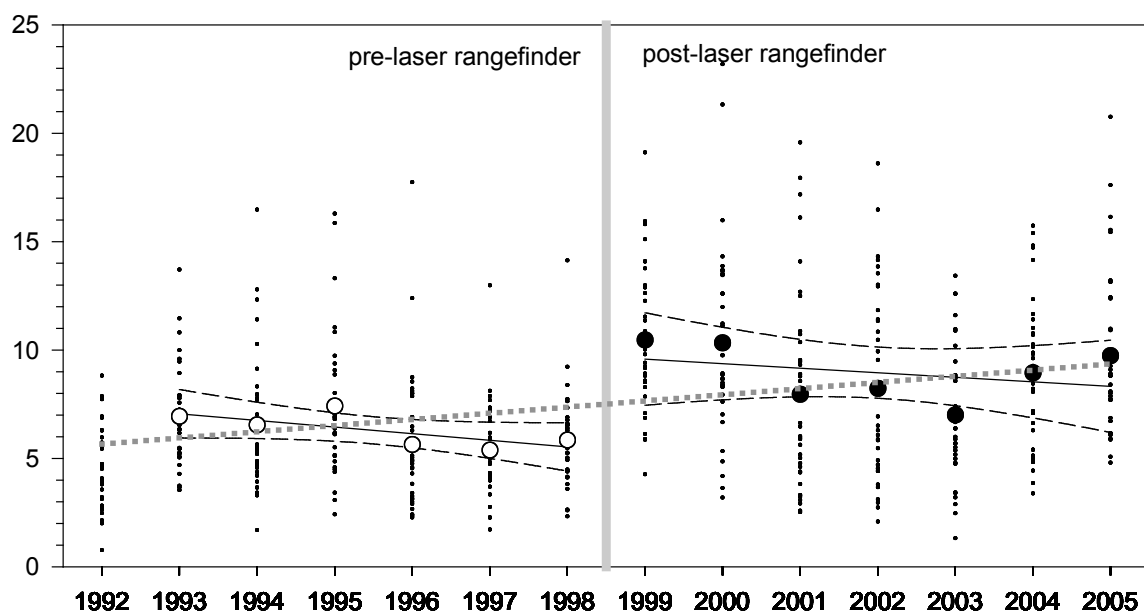


FIG. 7. Trends in mean stateside riparian bird densities (birds/ac) for all species pooled. Three trend lines are shown: the “naïve” linear trend for all sites in all years, and both pre-and post-implementation of the laser range-finder methodology.

per survey in 473 total surveys (Table 5). The highest number of species observed in a single year was 108 in 1995, and the lowest number of species observed was 71 in 1992 (Table 2). Of these, 47 species were observed in all 14 years, and 63 species being observed in all but one year. Of the 166 total species observed at BLM sites, 10 species accounted for over half (51.1%) of the total observations, and 75.4% of all birds counted were represented by 26 species. The most abundant species observed was Spotted Towhee accounting for 14% of the total observations. There were 20 species that were represented by a single individual (Table 5). A total of 30 species were recorded at all BLM sites and 40 species were observed at all but one of the BLM sites. In addition, there were 31 species observed at only one site. The highest number of species observed on BLM lands was 109 at the St. George survey site, and the lowest number of species observations occurred at the Fish Springs site with 54 species tallied (Table 2). The highest number of individual birds also occurred at the St. George site where 8,207 total observations were recorded for an average of 586 birds/year (Appendix A). The fewest number of individual birds observed occurred at the Fish Springs site where 1,061 birds were recorded for an average of 106 birds/year (Appendix A). The Fish Springs site had the highest average number of birds observed on a given survey at 149.7 birds/survey. The least average occurred at the Seep Ridge site with 58.9 birds/survey (Appendix A).

USFS Survey Sites All surveys at USFS sites began in 1992 (Table 2). A total of 48,982 birds representing 152 species were recorded at USFS survey sites between 1992 and 2005 for an average of 3,499 birds per year and 104.7 birds per survey in 468 total surveys. The highest number of species observed in a single year was 100 in 1998, and the lowest number of species observed was 76 in 1992 (Table 2). Of these, 34 species were observed in all years surveyed, and 64 species being observed in all but one year (Table 6). Of the 166 total species observed at

USFS sites, 10 species accounted for over half (51.3%) of the total observations, and 75.3% of all birds counted were represented by 23 species. The most abundant species observed was American Robin accounting for 10.4% of the total observations. There were 15 species that were represented by a single individual. A total of 30 species were recorded at all USFS sites and 40 species were observed at all but one of the USFS sites. There were 32 species observed at only one site. The highest number of species observed on USFS lands was 107 tallied at the Dutch John survey site, and the lowest number of species observations occurred at the Provo survey site with 71 species tallied (Appendix A). The highest number of individual birds also occurred at the Nephi site where 8,346 total observations were recorded for an average of 596 birds/year (Appendix A). The fewest number of individual birds observed occurred at the Beaver site where 1,846 birds were recorded for an average of 132 birds/year. The Delta survey site had the highest average number of birds observed on a given survey at 133.8 birds/survey. The least average occurred at the Beaver site with 65.9 birds/survey.

USFWS Survey Sites Point transect surveys at both USFWS sites began in 1992 (Table 1). A total of 12,617 birds representing 139 species were recorded at USFWS survey sites between 1992 and 2005 for an average of 1,123 birds per year and 165.4 birds per survey in 95 total surveys (Table 7). The highest number of species observed in a single year was 82 in 1995, and the lowest number of species observed was 42 in 2003 (Table 2). A total of 21 species were observed in all years, while 27 species were observed in all but one year of the survey (Table 7). Of these, 85 species were observed at both sites, while 50 species were observed at only one site. A total of 152 species accounted for over half (50.7%) of the total observations, and 76.7% of all birds counted were represented by 18 species. The most abundant species observed was Yellow Warbler accounting for 13.4% of the total observations. There were 19 species that were

represented by a single individual (Table 7). A total of 111 species were recorded at the Tremonton site and 110 species were observed at the Vernal site (Appendix A). The most individual birds were observed at Vernal (6,372) with the least number of birds observed at Tremonton (6,245). Vernal averaged 575 birds/yr and Tremonton averaged 589 birds/yr. There were 32 species observed at only one site. The highest number of species observed on USFS lands was 107 tallied at the Dutch John survey site, and the lowest number of species observations occurred at the Provo survey site with 71 species tallied (Appendix A). The highest number of individual birds also occurred at the Nephi site where 8,346 total observations were recorded for an average of 596 birds/year. The fewest number of individual birds observed occurred at the Beaver site where 1,846 birds were recorded for an average of 132 birds/year. The Delta survey site had the highest average number of birds observed on a given survey at 133.8 birds/survey. The least average occurred at the Beaver site with 65.9 birds/survey.

NPS Survey Sites Point transect surveys at both NPS sites began in 1992 (Table 1), and a total of 79 surveys have been conducted through 2005. A total of 6,357 birds representing 113 species were recorded at NPS survey sites between 1992 and 2005 for an average of 454 birds/year and 80.5 birds/survey (Table 4). The highest number of species observed in a single year was 61 in 1995, and the lowest number of species observed was 32 in 1992 (Table 3). A total of 9 species were observed in all years, while 20 species were observed in all but one year of the survey (Table 8). Of these, 68 species were observed at both sites, while 45 species were observed at only one site. A total of 9 species accounted for over half (50.6%) of the total observations, and 76% of all birds counted were represented by 21 species. The most abundant species observed was American Robin accounting for 14.2% of the total observations; there were 18 species that were represented by a single individual (Table 8). The most individual birds

were observed at Loa (4,760) with the least number of birds observed at Kanab (1,597). Loa averaged 340 birds/yr, while Kanab averaged 114 birds/yr. There were 45 species observed at only one site. The Loa site averaged 95.2 birds/survey and Kanab averaged 55.1 birds/survey. At least 30 species were only observed at Loa and 15 species were only observed at Kanab.

BOR, UDWR, & Private Land Survey Sites (sites are treated separately) The Salt Lake City (SLC1) BOR / URMCC site has been surveyed since 1992 (Table 1), and holds the record for highest number of birds observed for all 37 sites: a total of 13,559 birds representing 112 species were tallied between 1992 and 2005 (Appendix A). Counts averaged 969 birds/year and 202.4 birds/survey, and a total of 67 surveys were conducted. The highest number of species observed in a single year was 67 species tallied in 1999 (highest richness in study to date), and the least number of species observed during a single year was 32 species in 2003 (Table 3). Fifteen species were observed in all years of the survey, and 25 species were observed in all but one year, and 12 species were represented by a single individual (Appendix A). Of the total species observed at SLC1, 5 species accounted for over half (51.7%) of all birds counted, and 16 species accounted for 75.7% of all birds counted (Appendix A). The most abundant species observed was Yellow Warbler accounting for 23.7% of the total (Appendix A).

The Duchesne (DUCHES) DWR site has been surveyed since 1995 (Table 1), and there have been 3,366 birds observed between 1995 and 2005, representing 93 species (Appendix A). Counts averaged 306 birds/year and 146.3 birds/survey, with a total of 23 surveys completed. The highest number of species observed in a single year was 50, tallied in 2001, and the least number of species observed during a single year was 32, tallied in both 1996 and 2005. Six species were observed in all years of the survey, and 14 species were observed in all but one year. There were 10 species that were represented by a single individual (Appendix A). Of the

species observed at Duchesne, five accounted for over half (50.2%) of all birds counted, and 17 species accounted for 75.1% of all birds counted. The most abundant species observed was the Yellow Warbler, accounting for 17.1% of the total (Appendix A).

The Indian Peak (INDIAN) DWR site has been surveyed continuously since 1995 (Table 1), and there have been 1,949 birds observed between 1995 and 2005 representing 86 species (Appendix A). Counts averaged 195 birds/year and 88.6 birds/survey, and a total of 23 surveys were completed. The highest number of species observed in a single year was 43 species tallied in 2000, and the least number of species observed during a single year was 24 species in 1997. Ten species were observed in all years of the survey, and 14 species were observed in all but one year. There were 17 species that were represented by a single individual (Appendix A). Of the total species observed at Indian Peak, 8 species accounted for over half (51.2%) of all birds counted, and 20 species accounted for 75.9% of all birds counted. The most abundant species observed was Spotted Towhee accounting for 16.9% of the total (Appendix A).

The Ogden (OGDEN) DWR site has been surveyed since 1992 (Table 1), and 3,616 birds have been observed between 1992 and 2005 representing 87 species (Appendix A). Counts averaged 258 birds/year and 129.1 birds/survey, and a total of 28 surveys were completed. The highest number of species observed in a single year was 43 species tallied in 2004, and the least number of species observed during a single year was 28 species in 1996. Twelve species were observed in all years of the survey, and 13 species were observed in all but one year. There were 12 species that were represented by a single individual (Appendix A). Of the total species observed at Ogden, 7 species accounted for over half (53.5%) of all birds counted, and 15 species accounted for 75.1% of all birds counted. The most abundant species observed was Yellow Warbler accounting for 14.7% of the total (Appendix A).

The Tooele (TOOELE) private land site has been surveyed since 1992 (Table 1), and there were 2,876 birds representing 78 species tallied at the site between 1992 and 2005 (Appendix A). Counts averaged 205 birds/year and 102.7 birds/survey, and a total of 28 surveys were completed. The highest number of species observed in a single year was 42 species tallied in 2004, and the least number of species observed during a single year was 29 species in 1996. Eight species were observed in all years of the survey, and 13 species were observed in all but one year. There were 14 species that were represented by a single individual (Appendix A). Of the total species observed at Tooele, nine species accounted for over half (52.5%) of all birds counted, and 19 species accounted for 75.7% of all birds counted. The most abundant species observed was Warbling Vireo accounting for 10.4% of the total (Appendix A).

Constant Effort Mist Net Surveys

Constant effort mist net surveys began in 1994 at four selected sites, and increased to eight sites by 2005 (Table 2). Mist net survey effort has totaled 54,891 net hours in 945 total survey days (Tables 2 and 9). The number of bird encounters per net hour ranged from a low 0.33 (birds/net hr) in 1999 (7 sites) to a high of 0.51 (birds/net hr) in 1996 (5 sites). The average birds per net hour (all sites, all years), was 0.43 birds per net hour (Table 9). There were 143 total species captured at all banding sites between 1994 and 2005 with a total of 23,547 birds encountered and identified to species (23,572 total encounters; 25 birds not identified to species) (Table 10). The highest number of species encountered during a single year was 88 species in 2002 (eight sites) and the least number of species encountered during a single year was 44 species observed in 2003 (eight sites) (Table 11). The highest number of birds encountered was 2,790 in 2003 (eight sites) and the lowest was 958 in 1995 (five sites) (Table 12). Of 143 species captured, 23 common species were encountered at all eight banding sites, and 47 species

TABLE 9. Constant effort mist net survey summary. Total net hours, bird encounters, and birds per net hour by year for all sites (pooled) are given.

Year	Number of sites	Survey days	Net hours	Bird encounters	Birds / hr
1994	4	49	2484.2	1013	0.41
1995	5	54	2750.2	958	0.35
1996	5	60	3775.3	1936	0.51
1997	6	72	4499.9	2138	0.48
1998	7	82	4972.2	1849	0.37
1999	7	82	4910.0	1608	0.33
2000	7	84	5062.5	2285	0.45
2001	7	83	5052.5	1718	0.34
2002	8	96	5844.7	2651	0.45
2003	8	97	5810.9	2791	0.48
2004	8	95	5164.5	2630	0.51
2005	8	91	4564.2	1995	0.44
Total	8	945	54891.1	23572	0.43

were encountered during every year between 1994 and 2005 (12 years), and 47 species were netted in all but one year (Table 12). Eight of the most common species accounted for at least half (51.3%) of all birds encountered and 76.1% of all bird encounters were from 22 species; the most abundant species encountered at statewide was Yellow Warbler, which accounted for 18.1% of total encounters (Table 12). There were 78 less common species that were encountered in at least six of 12 years and 110 species were encountered in more than one year. There were 48 species encountered at only one banding site and 29 species that were encountered only once (Table 12).

BLM Mist Net Survey Sites Between one and four banding sites have been operated on BLM lands between 1994 and 2005 (Tables 1 and 2). The number of BLM banding sites has increased from one site in 1994 to two sites in 1997 to three sites in 1998 and four sites from 2002-2005 (Tables 1 and 2). Mist net surveys have totaled 384 days and have totaled 22,827.6 net hours (Table 13). The number of bird encounters per net hour ranged from a low of 0.18

birds/net hr in 2001 (3 sites) to a high of 0.44 birds/net hr in 1995 (1 site). The average birds per net hour (all sites, all years), was 0.28 birds per net hour (Table 13). There were 115 total species captured at all 4 BLM banding sites between 1994 and 2005 with a total of 6,331 total birds encountered (identified to species) (6,349 total encounters, 18 birds not identified to species) (Table 14). For the four BLM sites combined, the highest number of species encountered during a single year was 71 species in 2002 (4 sites) and the least number of species encountered during a single year was 34 species observed during 1995 (1 site) (Appendix C). The highest number of birds encountered was 981 in 2002 (4 sites) and the lowest was 213 in 1994 (1 site) (Table 13). Of the 115 species captured, 32 common species were encountered at all 4 banding sites, and 14 species were encountered during every year between 1994 and 2005 (12 years), and 24 species were netted in all but one year (Table 15). Nine of the most abundant species accounted for at least half (50.3%) of all birds encountered and 75.9% of all bird encounters were from 23 species (Table 14). The most abundant species encountered at 4 BLM sites was Yellow Warbler, which accounted for 13.4% of total encounters (Table 15). There were 54 less common species that were encountered in at least 6 of 12 years and 84 species were encountered in more than one year (Table 15). There were 49 species encountered at only one banding site and 26 species that were encountered only once (Table 15).

USFS Mist Net Survey Sites Between two and three banding sites have been operated on USFS lands between 1994 and 2005 (Tables 1 and 2). The number of banding sites has increased from two sites in 1994 to three sites from 1995-2005. Mist net surveys during this period totaled 417 days and 23713.8 net hours (Tables 2 and 16). The number of bird encounters per net hour ranged from a low 0.28 birds/net hr in 1995 (3 sites) to a high of 0.71 birds/net hr in 2003 (3 sites) (Table 16). The average for all sites across all years was 0.46 birds per net hour

(Table 16). There were 89 total species captured at all three USFS banding sites between 1994 and 2005 with a total of 10,811 total birds encountered (Tables 16 and 17). For the three USFS sites combined, the highest number of species encountered during a single year was 56 species in 1996 (3 sites) and the least number of species encountered during a single year was 39 species observed during 1994 (2 sites) and 2005 (3 sites) (Table 18). The highest number of birds encountered was 1504 in 2003 (3 sites) and the lowest was 436 in 1994 (2 sites) (Table 17). Lowest total bird encounters with all 3 sites was 447 birds in 1995. Of the 89 species captured, 43 common species were encountered at all three banding sites, and 25 species were encountered during every year between 1994 and 2005 (12 years), and 33 species were netted in all but one year (Table 18). Seven of the most abundant species accounted for at least half (53.6%) of all birds encountered and 76.3% of all bird encounters were from 16 species (Table 17). The most abundant species encountered at 3 USFS sites was Warbling Vireo, which accounted for 11.1% of total encounters (Tables 17 and 18). There were 49 less common species that were encountered in at least 6 of 12 years and 73 species were encountered in more than one year (Table 18). There were 27 species encountered at only one banding site and 14 species that were encountered only once (Table 18).

BOR Mist Net Survey Site The sole BOR site is the SLC1 banding station. It has been in operation since 1994, for a total of 12 years (Tables 1 and 2). Mist net surveys have totaled 142 days and have totaled 8,349.7 net hours (Table 19). The number of bird encounters per net hour at SLC1 ranged from a low of 0.45 birds/net hour in 1995 to a high of 1.16 birds/net hour in 2000, for an average of 0.77 birds per net hour (Table 19). There were 71 total species captured at Salt Lake City 1 between 1994 and 2005 with a total of 6,412 total birds encountered (Table 20). The highest number of species encountered during a single year was 43 species in 1998 and

the least number of species encountered during a single year was 32 species observed during 1995 (Table 20). The highest number of birds encountered was 861 in 2000 and the lowest was 225 in 1995 (Table 19). Of 71 species captured, 13 species were encountered during every year between 1994 and 2005 (12 years), and 18 species were netted in all but one year (Table 20). Three of the most abundant species accounted for at least half (54.6%) of all birds encountered and 76.5% of all bird encounters were from 8 species. The most abundant species encountered at SLC1 was the Yellow Warbler, which accounted for 37% of total encounters (Table 20). There were 37 less common species that were encountered in at least six of 12 years and 57 species were encountered in more than one year, and 11 species that were encountered only once (Table 20).

Survival Probability Trend Estimates Preliminary trends in recapture and survivorship rates were estimated from mist net recapture data using program MARK for all species combined and are presented in Figs. 8 to 11. Mean annual recapture probability ranged from just less than 10% to just over 20% (Fig. 8), and from just under 7.5% to just over 16% for each site (mean 12.8%), pooled across all available years for each site (Fig. 9). The highest recapture rate occurred in 1996, the lowest in 1995. The large difference between 1995 and 1996 is attributable to this being the first full season available for recapture post banding implementation (1994) and the expected low sample sizes involved due to the limited effort in that earliest capture period. Since 1996, and explicitly accounting for differential survey effort, there has been a generally decreasing trend (-0.05% year, adj. $r^2 = 0.51$, $p = 0.009$), in the mean recapture probability for all species statewide (Fig. 8). Excluding the first year data (for reasons outlined above), a linear model of survivorship (trend) for all species also show a non-significant (at alpha of 0.10) decreasing trend of approximately 2% per year (Fig. 10). Apparent annual survivorship ranged

from a low of 0.32 in 1995 to a high of 0.55 in 1996 (mean = 0.43) (Fig. 10). Significant differences between individual study sites were observed (Fig 11). Mean per/site survivorship was slightly over 40%, while SMOKEY has the lowest estimated survivorship (0.28), and RUSHVA the highest (0.48) (Fig. 11).



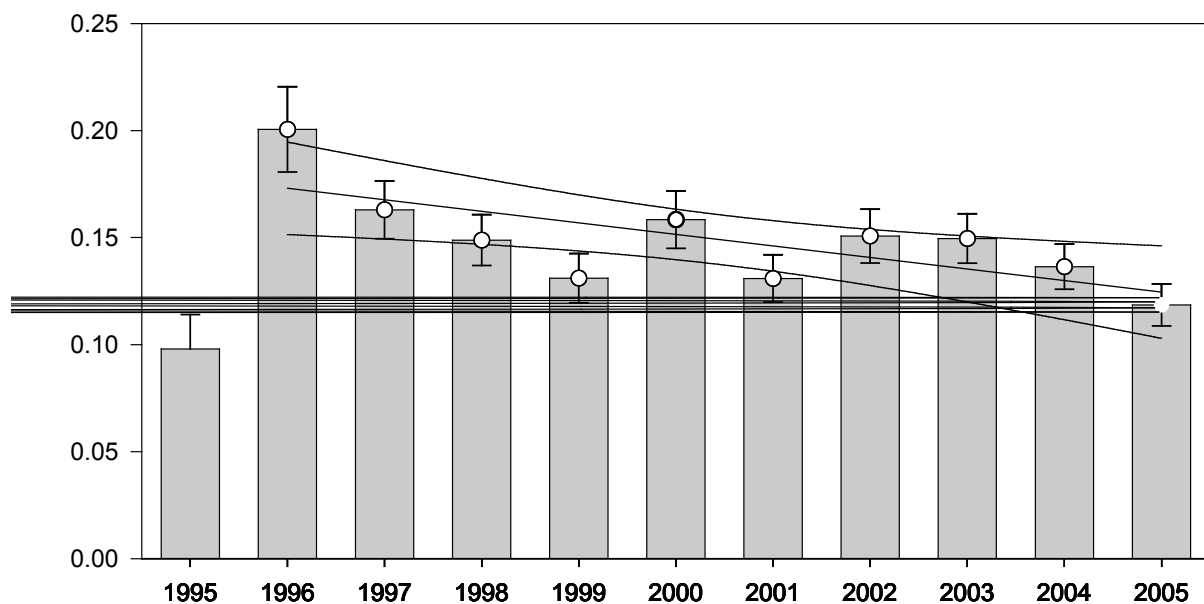


Fig. 8. Estimated annual recapture rate for all riparian birds across all sites, with linear trend in recapture rate shown for 1996-2005. Note that estimates from first year returns are biased low and were excluded from the trend estimate for this reason

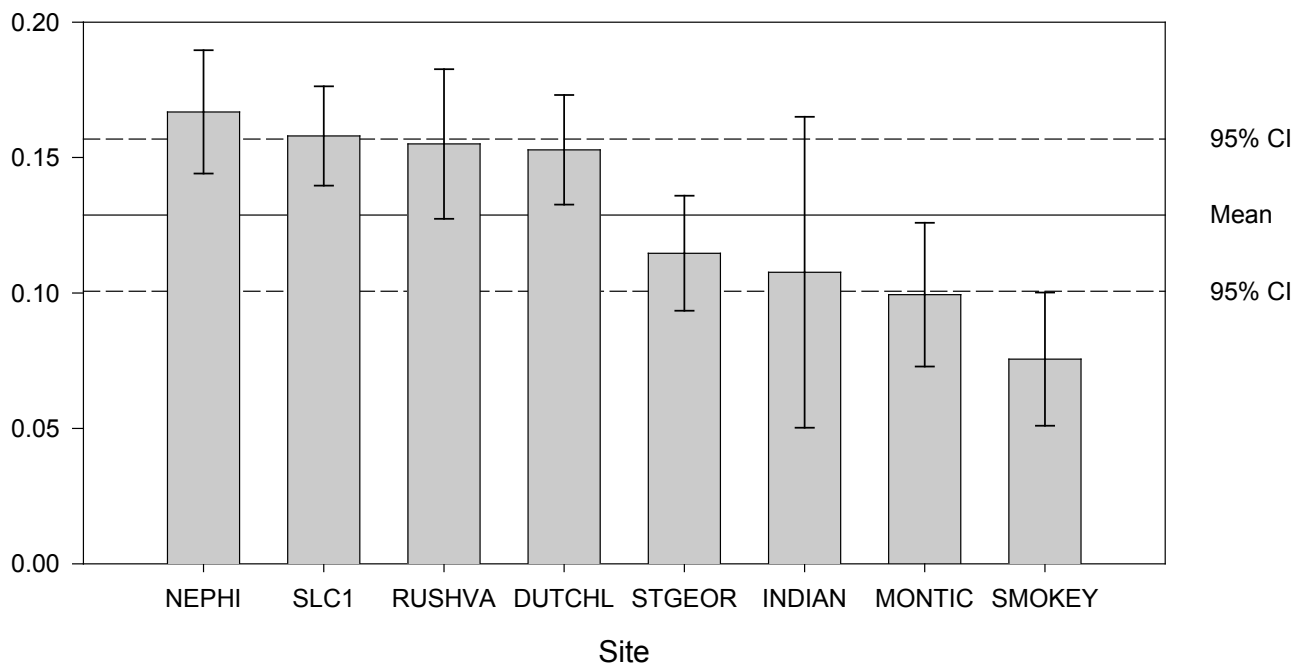


Fig. 9. Estimated recapture rate by site for all species pooled across all years.

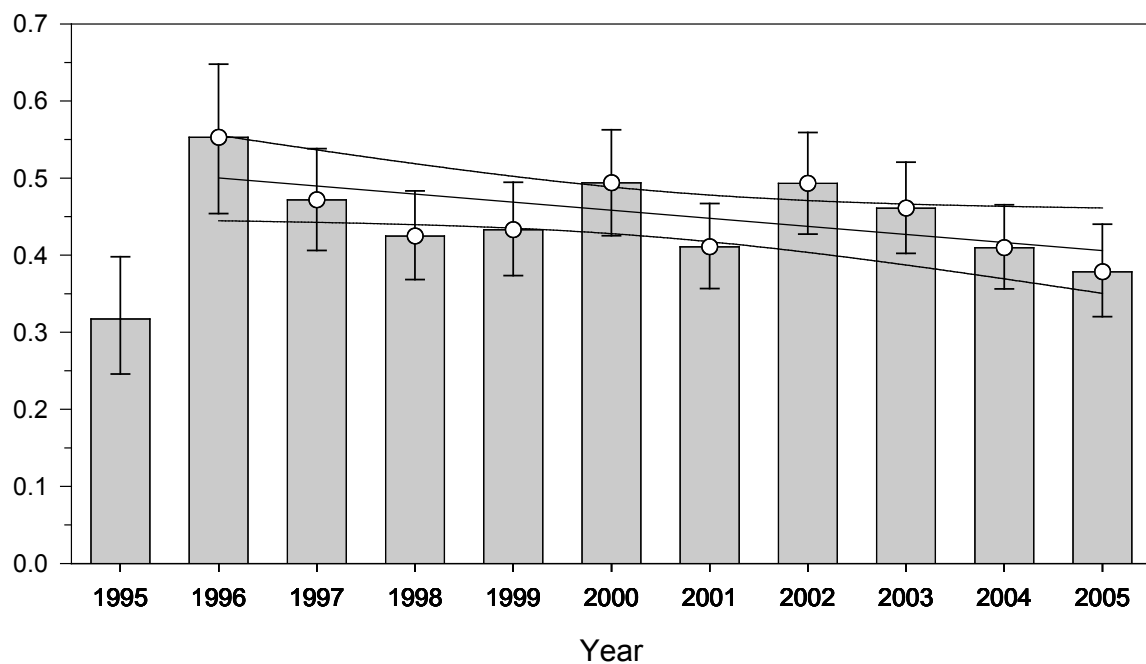


Fig. 10. Estimated annual survival rate for all riparian birds across all sites, with linear trend in survival rate shown for the 1996-2005 period. Note that estimates from first year returns are biased low and were excluded from the trend estimate for this reason

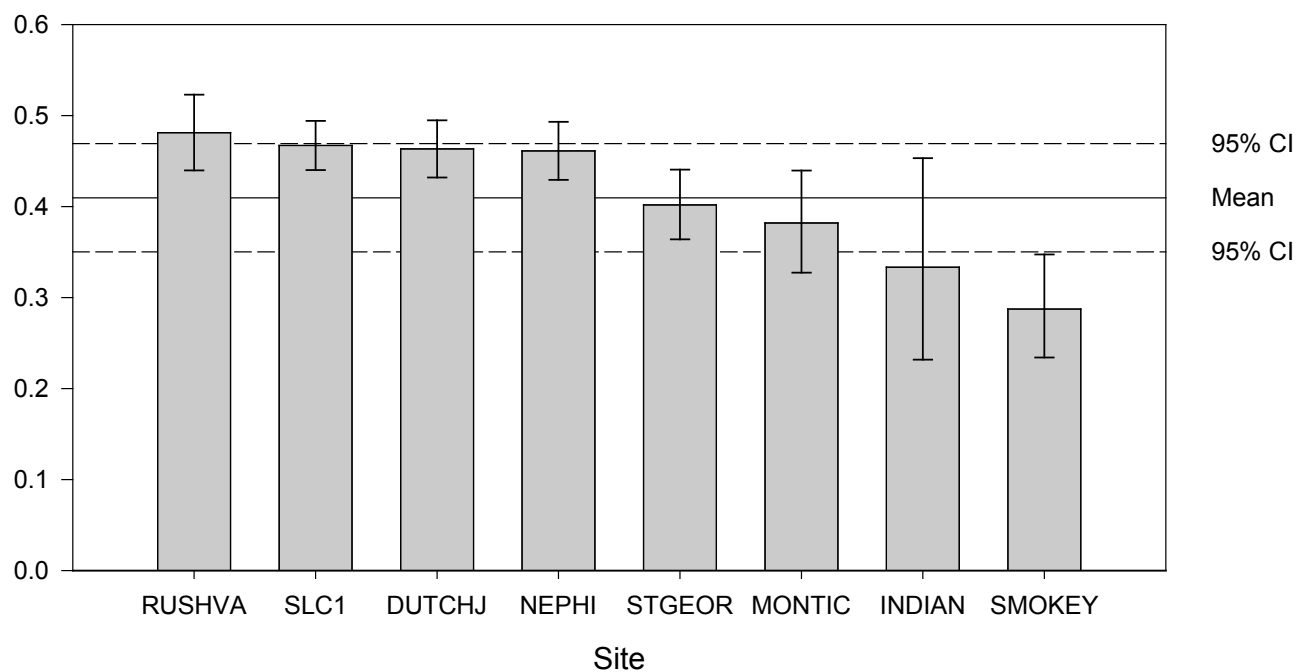


Fig. 11. Estimated survival rate by site for all riparian birds pooled across all years

DISCUSSION

What does 14 years of riparian bird monitoring tell us?

Fourteen years of riparian bird population monitoring has met our initial study goals, and definitively answered the question of whether or not Utah's riparian bird populations are declining. They are, and at a rate that confirms the designation of riparian habitats as Utah's highest conservation priority. Our 2002 Utah Partners in Flight status report, the Utah Avian Conservation Strategy (Parrish et al. 2002), made it clear that many riparian species were declining enough to warrant conservation status. That document was a largely 'data-free' evaluation: in the absence of comprehensive local information, we necessarily relied upon regional and national datasets. Now, the results of the monitoring data presented in this report confirm that prioritization of riparian habitats as *the* Utah habitat "in greatest conservation need." Clearly these data hold answers to many more questions of management interest, and more detailed analyses will enable us to address these often species- and physiographic-specific questions. While details remain to be filled in, the overall trend shown in these data is clear.

Our sole community measure, mean species richness, did not show any trend from 1992 - 2005. While alpha diversity measures such as richness are wholly insensitive to changes in relative abundance, and important changes in community composition can be masked via species substitution, we have seen no significant changes in the statewide riparian community composition. Richness measures help to establish species lists, and provides another dimension to between site comparisons. These data will be used most directly in our up-coming species-habitat modeling effort (see below).

Our initial study goal for the count portion of the study was to determine if riparian bird populations were declining more than 5% per year over 10 years, with 80% power, and with a

significance level of 0.05 or less. Once the shift in field methodology has been accounted for, linear trend results show declines across all species of 5 to 7% per year, and are comfortably within power analyses predictions prepared in conjunction with earlier analyses (Norvell et al. 2005) using 1992-2001 data. These suggested our study goal was being met on schedule for the total riparian community and for the larger aggregations of species (e.g., taxonomic groupings, physiographic regions). For individual species, these power analyses also predicted sufficient power for linear trend models would be, or had already been met, for the top 13 most frequently detected species, and that other species individual trends would be met (at average rates of detections) at a rate of 2-3 species per additional year of survey. We would expect that individual, species-specific linear trend models would be appropriate for between 21 and 25 species through 2005. These analyses are planned for the spring of 2009.

Our initial study goal for the banding portion of the study (begun in 1994) was to investigate mechanisms of population change by describing differences in survivorship between species and between adult and juvenile age groups, and to describe annual and site-specific differences in productivity between species. Our initial analyses presented here indicate no significant trend in survivorship for all riparian species taken together, one of the primary concerns when this portion of the study was initiated. Estimated annual survivorship remains low, however, at less than 40%. Potentially masking this conclusion is the low and decreasing recapture probability (mean recapture rate is roughly 15%), indicating that statistical power to detect important trends decreases in the latter years of the study period along with decreasing sample sizes. These statewide trends are also dominated by the relatively higher capture and recapture rates for four sites (NEPHI, SLC1, RUSHVA, and DUTCHJ) of the eight sites, making the inference from these data to statewide patterns in survivorship less uniform.

To date, portions of our initial study goals for the banding segment of the study design have been met and others have not. Low sample sizes have hampered our ability to draw inference beyond the aggregated approach detailed here. A broad view of riparian bird survivorship has been gained, but we have not learned much yet about productivity. Similar to the count portion of the study, however, many more detailed analyses are also possible or already planned. Planned analyses for the 2009 spring periods include survivorship estimates by site and year for the approximately 14 species for which the data support such a detailed approach (i.e., $n > \sim 70$ recaptures). As there is a trade-off in statistical power between temporal, spatial, and taxonomic resolution, it will be possible to create annual estimates for only a few species at the individual site scale. Most will require more or less aggressive pooling in one category or another to create sufficiently large datasets to analyze. Survivorship estimates by broader taxonomic groupings of interest (e.g., low-canopy warblers) by site and year, and species-specific survivorship estimates by site (for all years pooled), and by year (all sites pooled) will be attempted for the approximately 17 relatively commonly captured species (i.e., $n > 50$ recaptures).

For both the count and banding portions of the study, inter- and intra-annual variability was large, albeit expectedly so for large-scale and long-term migratory bird research. There were, as expected, large and significant differences between sites and years. This variability is inevitable in such studies, and systemic (e.g., statewide or larger) annual variation can only be estimated and accounted for through long-term sampling such as we have done. The sources of this variation may be reasonably attributed to large-scale patterns in weather and climate interacting with species distributions, productivity, migration and breeding-season timing, and over-winter survivorship, and these continental-to-regional-to-landscape scale trends drive the

bulk of the variation we have observed at statewide scales (Katrin 1997, Hurlbert and Haskell 2003, Currie et al. 2004, Wiens and Graham 2005, Hawkins et al. 2007). This variation underlies, interacts with, and to a degree confounds the more direct anthropogenic sources of change (direct effects, impacts) whose direction and magnitude we would like to estimate. Some direct effects are intentional (e.g., management actions), some not (e.g., horticultural importation of invasive plant species), but both are potentially important for they are the ones over which we have the greatest responsibility for and influence.

The identification and estimation of these sources of variation, the interactions between regional, landscape, intermediate, and local scales of variation, and their respective impacts on species (i.e., abundance) and community (i.e., richness) trends are all active areas of research (Cushman and McGarigal 2002, Hawkins et al. 2003, Cushman and McGarigal 2004, Peres-Neto et al. 2006). Here we have chosen one scale of inference all riparian habitat in Utah and have described the trends in abundance and survivorship for all birds observed in this habitat. Our next steps in the analysis will necessarily delve into more detail with regard to unique species and species groupings of interest (e.g., Utah Wildlife Action Plan Tier II and III species, Gorrell et al. 2005), individual scales or particular spheres of interest (e.g., physiographic regional trends, agency-specific trends, elevation, or sub-habitat categories), and site specific trends and management action specific impact analysis. These latter two represent the finest scales at which we envisioned these data would potentially be useful, and these uses go beyond the descriptive approach used in this report. The broad context approach has many current uses however. There is a growing demand to use these data as a rich and multi-scaled reference standard for experimental and correlational approaches. For example, the hundreds of on-going riparian restoration projects sponsored by the Utah Partners for Conservation Development (now the

Watershed Restoration Initiative) since 2003 currently lack reference standards by which they can measure their relative success. We are hopeful that this program and other like it will use these results to evaluate the impact of their work in the rich context of statewide, physiographic, and local trends. Additional analyses incorporating weather, climate, and landscape context is also planned for these data, further widening their utility.

We assume that much of the variation described here is mediated by vegetation composition, structure, and community dynamics, and are actively engaged in modeling these species-habitat relationships (draft versions expected in spring 2009, H. White, Pers. Comm.). The variation in vegetation dynamics that follows both natural and ‘unnatural’ effects mediate and interact with both large and small scale sources of environmental variation. We have recognized the importance of accurately describing the riparian habitat from the start of the work, and have conducted comprehensive vegetation sampling approximately every three years. The analysis of these data are on-going and are beyond the reach of this report, but will necessarily include both species-specific and community analyses of these relationships. Their compilation into riparian bird community-habitat correlational models is anticipated in the spring of 2009.



FUTURE DIRECTION

A comprehensive evaluation of the existing riparian monitoring program has begun, and particular components of this study being evaluated include:

- Ranking and scheduling proposed analyses,
- Assessing the effort required to bring riparian monitoring (counts) into a spatial sampling framework;
- Assess the banding portion of the program:
 - Can sampling methodologies be modified to sufficiently increase sample sizes to required levels without losing data continuity with current dataset?
 - If sites unable to meet projected power thresholds are dropped, will this portion of the study remain viable?
 - If sites unable to meet projected power thresholds are replaced, what will the impact be on the sphere of inference, when will trend data be available, and what will it cost?

We are pleased that most of the habitat goals and priority species identified in precursors to this report (i.e., Parrish et al. 2002) were transmitted intact to the Utah Wildlife Action Plan (Gorrell et al. 2005). Efforts to make the Action Plan ‘actionable’ with specific tasks and timelines are underway, with assistance from the Nature Conservancy (J. Gragg, UDWR, Pers. Comm.). We recommend strongly these processes be coordinated with partner agencies, such that restoration actions taken are appropriate to the level of need. These data can help the DWR and our partners make informed decisions and correctly prioritize activities through holistic planning. The hallmark of good planning has always been that the right work gets done at the right time and in the right place. Modern additions to this adage might include the flexibility and wisdom to change course via an adaptive management approach, and that all our management factors operate at the right scales.

MANAGEMENT RECOMMENDATIONS

Riparian habitat comprises approximately 0.4% of Utah's landscape and is used by over 70% of Utah's Neotropical migratory birds (Parrish et al. 2002). The importance of riparian habitat to the conservation of Utah's riparian birds cannot be over-stated. The threats that brought it to the fore in the early 1990's remain from the same today: competing demands on water, channelization, fire cycle alterations, improper grazing practices, OHV use, invasive plants, timber harvest, and urban/exurban development, and energy development pressures. Declining trends observed in this study are likely reflective of a combination of these. In addition, we have come to recognize that threats occur at all possible scales: global, regional, landscape/watershed, and local. Most interact, and do so across temporal and spatial scales; riparian systems in particular inherit 'upstream' factors as well as on-site threats necessarily broadening threat assessments. Some impacts are chronic, others acute, and our ability to directly affect any one of them varies (Poff et al. 1997, Naiman et al. 2005, Sutter et al. 2005). While all these scales can be entry points into conservation and restoration, the first step should be 'passive' restoration (*sensu* Kauffman et al. 1997): the removal or mitigation of egregious impacts at the scale of management: the reach, the district, and the region.

Despite these challenges, it is incumbent on land managers to broadly re-emphasize the conservation of riparian habitats; an emphasis that is or should already be reflected in our resource management and land use planning processes. Key factors used in assessing riparian functionality include hydrologic, vegetative, and erosion deposition as well (Gardiner et al. 1999). Routine measurement of these factors should be included in evaluating avian responses to management. In short, an adaptive management approach is called for to properly evaluate,

take action, and then follow-up with monitoring and evaluation of the response to actions taken. Included in this process should be the identification of the source of each negative impact on the resource, the appropriate conservation action to be implemented, and a plan to do so.

At least one additional global scale threat that was not considered at the initiation of this study is climate change, a threat that should also be included in resource and land-use management plans and overall conservation planning efforts. The temporal extent of these data allows for assessing long-term correlational studies of weather and climate now and into the future. More specific management recommendations may be evaluated in detail when a) species-habitat models, and b) species- and site-specific trend evaluations are completed (expected spring 2009). These more specific management guidelines will be needed to assess conservation actions and riparian attributes considered important to priority migratory bird species. Conservation measures are needed to address specific management activities that occur within riparian habitats (e.g., recreation, logging, grazing). Individual species that are declining should receive special emphasis to avoid regulatory actions.

To our knowledge, this study has produced the longest running dataset on western riparian systems to date, providing a much needed and unparalleled baseline. Through a cooperative partnership approach, this work demonstrates that the needed level of effort can be accomplished at a large scale and over long time frames. Our results provide a tangible example of what can be accomplished with consistent, determined, and cooperative effort among diversified partners. Through a robust sampling design that considers spatial spread, resulting data can often serve as a 'local' reference standard as well as providing a robust regional standard.

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